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SEMIMONTHLY

59

MAY 23, 1966

VOLUME 4 • NUMBER 10

N66-19786—N66-21105

DOCUMENTS

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Scientific and Technical Aerospace Reports, Volume 4, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget January 9, 1965

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- Scientific and technical reports of government agencies, universities, and research organizations throughout the world.

The first section of *STAR*, arranged in 34 categories, contains abstracts and bibliographic citations (see p. vi). A second section consists of five indexes: subject, corporate source, author, report/accession number, and accession/report number. Separate cumulative indexes are published quarterly, except for the fourth quarter, which is an annual index. Cumulative indexes also contain a contract number index.

Readers are encouraged to examine the abstracts in each category of interest. If time is short, and when interest is concentrated in specific areas, readers may wish instead to scan source, author, and subject indexes. A more thorough coverage of a subject field may often be achieved by detailed examination of the subject listings, especially as they are cross-indexed in the quarterly indexes.

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Organizations having a NASA contract may obtain *IAA* by writing NASA, Code USS-A, Washington, D.C., 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y. 10017.

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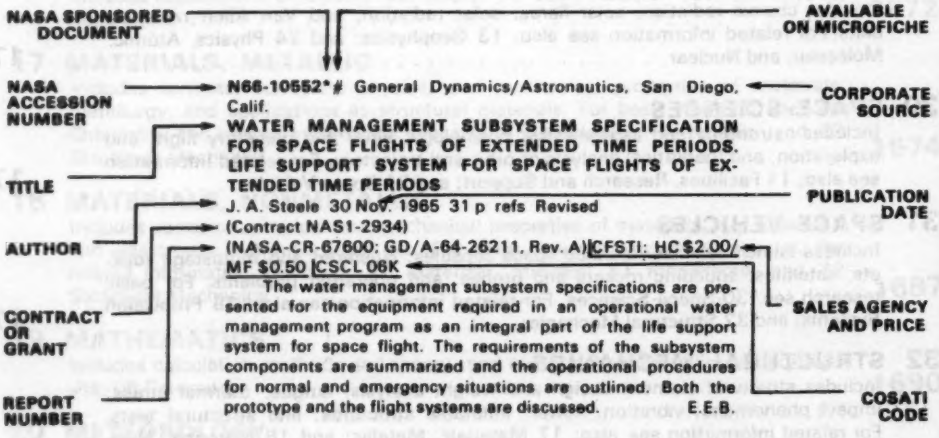
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N66-10552*# General Dynamics/Astronautics, San Diego, Calif.
CORPORATE SOURCE
TITLE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
PUBLICATION DATE
AUTHOR
J. A. Steele 30 Nov. 1965 31 p refs Revised
(Contract NAS1-2934)
CONTRACT OR GRANT
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $2.00/MF $0.50 CSCL 06K
SALES AGENCY AND PRICE
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed. E.E.B.
REPORT NUMBER
COSATI CODE

VOLUME 4 NUMBER 10

Scientific and Technical Aerospace Reports

A Semimonthly Publication
of the National Aeronautics and Space Administration

May 23, 1966

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-19898 Joint Publications Research Service, Washington, D. C.

OUR MINIATURE ROCKETS

Chung-yuan Lu and Chen-Hsuan Li *In its* Transl. on Communist China's Sci. and Technol., No. 296 3 Mar. 1966 p 20–24 (See N66-19893 10-34) CFSTI: $2.00

The design, construction, and performance of single and double stage miniature solid propellant rockets are described. The single stage rocket shell, constructed from an aluminum container, is 50 mm long and has a diameter of 19 mm. A 1:20 mixture of gunpowder and potassium chlorate is used for the propellant. The tail fins are of thin plywood and small slabs of wood glued together and fastened to the shell with thin wire. The cone is made of paper and also glued to the shell. Glass tubes are used for support in launching and ignition is by electric sparks. In a demonstrstion, 12 out of 18 single stage and 3 out of 6 double stage rockets were successfully launched. The single stage rockets were launched at 80 degrees, reaching an altitude of 150 to 200 meters in 3 to 4 seconds. The double stage rocket, launched from a vertical position, flew for more than 10 seconds and reached an altitude of over 300 meters. The double stage rocket construction, which is basically two single stage rockets, is also described. R.N.A.

N66-19938# Witwatersrand Univ., Johannesburg (South Africa). Dept. of Mechanical Engineering.

THE POTENTIAL FLOW SOLUTION OF THE PERIPHERAL JET OF AN AIR CUSHION VEHICLE APPLICABLE TO ALL H/T RATIOS

Thomas P. Bligh Dec. 1965 49 p refs (Rept.-30) CFSTI: HC $2.00/MF $0.50

Complete flow solutions, for both the deflected and split jet conditions, of the peripheral jet of an air cushion vehicle are developed. The new theories require no simplifying assumptions other than inviscid, incompressible flow. The assumptions that the jet thickness remains constant from the jet exit to the ground and that the jet curtain follows a circular path, which are made in existing theories, are avoided as they are not, in general, true, particularly at small h/t ratios. Application is therefore justified to all h/t ratios. The streamlines can be plotted using the present theory. Potential flow and conformal mapping techniques are used. Experimental results are compared with the new and the old theories. Author

N66-19971# Royal Aircraft Establishment, Farnborough (England).

ON THE MECHANICS OF BIRD FLIGHT [K YOPROSU O MEKHANIKE POLETA PTITS]

G. S. Shestakova Dec. 1965 25 p refs Transl. into ENGLISH from Zool. Zh. (Moscow), v. 35, no. 7, 1956, p 1043–1050 (RAE-LIB-TRANS-1141) CFSTI: HC $1.00/MF $0.50

Step by step movements of the inner and outer parts of the wings of gulls and terns, both in steady and unsteady flight conditions, are detailed. The twisting of the manus relative to the longitudinal axis of the wing is considered, and the aerodynamic forces produced by the twisting and producing the twisting are suggested. The author suggests that the wing muscles, other than the main pectoral muscle, are so weak that they have little effect upon the elevation, depression and twisting of the manus, and that the action of these muscles may be negative i.e. they only prevent movement of the manus in the "wrong" direction. Three main hypotheses on the effects of the slotted primary feathers are briefly discussed and the author suggests that each hypothesis is probably correct at some stage of flapping flight. Author

N66-19985# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.

ANALYSIS OF TRANSONIC FLOW BY MEANS OF PARAMETRIC DIFFERENTIATION Final Scientific Report, 1 Nov. 1964–30 Oct. 1965

Paul E. Rubbert Nov. 1965 179 p refs *Its* MIT Fluid Dyn. Res. Lab. Rept.-65-2
(Grant AF-AFOSR-156-65)
(AFOSR-65-1932; AD-626058)

A general method of solving nonlinear partial differential equations was developed and applied to the problem of inviscid transonic flow about airfoils. Solutions are given for nonlifting airfoils at all transonic Mach numbers, including those flows with detached shock waves, and extensions to include lifting and unsteady flows are discussed. Results are given for subsonic and supersonic flow, and for flows at Mach number unit which are in general agreement with other theoretical results and with experiment. Inadequacies in the numerical technique prevented the accurate computation of shock movements, but preliminary results indicate a rearward movement of the shock impinging on the airfoil surface with increasing airfoil thickness, and exhibit the commonly observed rapid acceleration behind the shock. The well known local linearization result of Spreiter and Alksne is shown to be an approximation to the present theory for subsonic flow. TAB

N66-19987*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF CONTROL EFFECTIVENESS AND STABILITY CHARACTERISTICS OF A MODEL OF A LOW-WING MISSILE WITH INTERDIGITATED TAIL SURFACES AT MACH NUMBERS OF 2.29, 2.97, AND 3.51

John G. Presnell, Jr. Washington, NACA, 14 Jul. 1958 33 p (NACA-RM-L58C19) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

Data were obtained for three settings of the longitudinal control surfaces: with deflection of all surfaces, with deflection of the lower surfaces only, and with all surfaces underflected. Directional stability data were obtained at M=3.51 for angles of attack of approximately 0° and 10°. These data, with summary data and typical schlieren photographs, are presented with only a brief analysis. The data indicate that the controls are effective throughout the Mach number range and lift-coefficient range (C_L=−0.15 to 0.7, approximately) of the tests. There is a severe break in the pitching-moment curve at M=2.29 which might result in a pitch-up condition in flight, and also a large forward movement of the aerodynamic center with increasing Mach number that produces neutral longitudinal stability at M=3.51 for the moment center used in this investigation. The model was directionally unstable at M=3.51; however, the level of directional stability was about the same for 0° and 10° angles of attack. Author

N66-19997*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL INVESTIGATION AT HIGH SUBSONIC SPEEDS OF THE EFFECTS ON STATIC STABILITY CHARACTERISTICS OF VARIOUS MODIFICATIONS TO A SWEPT-WING FIGHTER-TYPE AIRPLANE MODEL

Kenneth W. Goodson Washington, NACA 30 Apr. 1957 118 p refs (NACA-RM-L57A31) CFSTI: HC $4.00/MF $0.75 CSCL 01A (Declassified)

An investigation was made at high subsonic speeds of a model of a twin-engine swept-wing fighter-type airplane. The model was tested with several different tail configurations and with several wing and engine inlet modifications. The investigation was concerned primarily with longitudinal stability at a stabilizer incidence of 0°; however, a few stabilizer and lateral-derivative tests also were made. The model was tested in the Langley high-speed 7- by 10-foot tunnel at Mach numbers from 0.60 to 0.92. The results showed that a horizontal tail raised to the top of the vertical tail and moved forward from the original position gave substantial improvements in stability and delayed the angle of attack and lift coefficient at which pitch-up instability occurred. Use of a fixed horizontal surface, attached below the engine tail pipes, in combination with either the original or new horizontal tail (biplane arrangement) also provided substantial improvements in stability; however, the combination that included the new horizontal tail had better characteristics. Author

N66-19999# Wissenschaftliche Gesellschaft fuer Luft- und Raumfahrt, Brunswick (West Germany).

NONSTATIONARY AERODYNAMICS [INSTATIONARE LUFTKRAFTE]

Oct. 1965 224 p refs In FRENCH, ENGLISH, and GERMAN Rept. on the Combined Meeting of the Comm. on Aerodyn., Stability, and Aeroelasticity on 2 Apr. 1965 in Aachen (DLR-Mitt.-65-12) CFSTI: HC $6.00/MF $1.25

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3. EXPERIMENTAL AND THEORETICAL DETERMINATION OF UN-STATIONARY MEASURES ON OSCILLATING WINGS H. Bergh (Natl. Aero- and Astronautical Res. Inst.) p 98-134 refs (See N66-20002 10-01)
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N66-20000 Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

THE RESULTS OBTAINED AT O.N.E.R.A. IN THE FIELD OF UNSTEADY AERODYNAMICS [LES RESULTATS OBTENUS A L'O.N.E.R.A. DANS LE DOMAINE DE L'AERODYNAMIQUE INSTATIONNAIRE]

R. Dat *In* Wiss. Ges. fur Luft- und Raumfahrt Nonstationary Aerodyn. Oct. 1965 p 1-50 refs In FRENCH (See N66-19999 10-01) CFSTI: HC $6.00/MF $1.25

The three-dimensional flow theory was used to obtain accurate values for the aerodynamic forces that act on the wings of supersonic aircraft. The rudder problem at supersonic speed was analyzed by point integration instead of the usual numerical integral procedures. Comparison between experimental and theoretical values showed good agreement for wing aerodynamic values and to a somewhat lesser extent for the rudder calculations. G.G.

N66-20001 Royal Aircraft Establishment, Farnborough (England).

UNSTEADY AERODYNAMICS

D. L. Woodcock *In* Wiss. Ges. fur Luft- und Raumfahrt Nonstationary Aerodyn. Oct. 1965 p 51-97 refs (See N66-19999 10-01) CFSTI: HC $6.00/MF $1.25

The importance of incorporating unsteady flutter and gust response elasticity in the accurate determination of aerodynamic factors acting on aircraft wings and fins in supersonic flow was outlined. A solution to the linearized potential flow equation for the velocity potential that satisfies the required boundary conditions must be included in subsonic flow calculations to obtain the proper loading factor. The spanwise integration of collocation points was found inaccurate for obtaining downwash near the wing leading and trailing edges at high Mach number. Box methods of various types that treat a number of oscillation modes simultaneous proved advantageous for supersonic flutter analyses; an integral equation giving the downwash as integral of the velocity potential for a wind covered with a mesh of rhombuses whose sides were parallel to the Mach lines gave most accurate aerodynamic force values. G.G.

N66-20002 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).

EXPERIMENTAL AND THEORETICAL DETERMINATION OF UN-STATIONARY MEASURES ON OSCILLATING WINGS [EXPERIMENTELLE UND THEORETISCHE BESTIMMUNG INSTATIONARER DRUCKE AN SCHWINGENDEN TRAGFLUGELN]

H. Bergh *In* Wiss. Ges. Fur Luft- und Raumfahrt Nonstationary Aerodyn. Oct. 1965 p 98-134 refs In GERMAN (See N66-19999 10-01) CFSTI: HC $6.00/MF $1.25

Described is a new method for measuring the pressure distribution on harmonically oscillating wings by application of 30 evenly distributed pressure tube sensors fastened to the wing surface. A common distributor regulates the various pressure gradients and registers the static pressure differences automatically. Experimentally obtained values on three different wing models exposed to Reynolds number 2 through 8×10^6 showed good agreement with theoretical pressure computations. Transl. by G.G.

N66-20003 Vereinigte Flugtechnische Werke G.m.b.H. Munich (West Germany).
ON RESULTS OF EXPERIMENTAL AND THEORETICAL RESEARCH IN THE FIELD OF UN-STATIONARY AERODYNAMICS [UBER ERGEBNISSE DER EXPERIMENTELLEN DER INSTATIONAREN LUFTKRAFTE STAND DER FORSCHUNG IN DEUTSCHLAND]
B. Laschka *In* Wiss. Ges. fur Luft- und Raumfahrt Nonstationary Aerodyn. Oct. 1965 p 135-198 refs In GERMAN (See N66-19999 10-01) CFSTI: HC $6.00/MF $1.25

This review presents the basic problems and some calculation methods for unsteady aerodynamic phenomena. Structural elasticity of the airplane shell, wings, and fins induce oscillations that result in periodic increases of the aerodynamic forces acting on the plane, and can induce flutter. Calculations on the instationary stability derivations and their corresponding stabilizing forces, as applied to the problem of harmonically oscillating wings or bodies, use the equations for unstationary aerodynamics to describe pressure distribution in supersonic flow. Various evaluations for a number of modified wing profiles and an increasing range of Mach numbers are given. Transl. by G.G.

N66-20046*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF BOATTAIL AREA CONTOURING AND SIMULATED TURBOJET EXHAUST ON THE LOADING AND FUSELAGE-TAIL COMPONENT DRAG OF A TWIN-ENGINE FIGHTER-TYPE AIRPLANE MODEL
Willard E. Foss, Jr., Jack F. Runckel, and Edwin E. Lee, Jr. Washington, NACA, 14 Jul. 1958 70 p refs
(NACA-RM-L58C04) CFSTI: HC $3.00/MF $0.75 CSCL 01A (Declassified)

The effect of a fuselage modification and jet operation on engine-base and configuration drag of an airplane model with overhanging afterbody has been investigated in the Langley 16-foot transonic tunnel. Volume was added to the fuselage to improve the area distribution of the configuration. This modification incorporated streamline contouring at the wing roots and more extensive boattailing at the engine shrouds. Reductions in base and fuselage-tail drag resulted at subsonic speeds. Author

N66-20075*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF VERTICAL-TAIL SIZE AND A VENTRAL FIN ON THE STATIC LATERAL AND DIRECTIONAL STABILITY DERIVATIVES OF A 0.048-SCALE MODEL OF A HORIZONTAL-ATTITUDE VTOL AIRPLANE AT TRANSONIC SPEEDS
Walter B. Olstad Washington, NASA, Oct. 1960 66 p refs
(NASA-TM-X-35) CFSTI: HC $3.00/MF $0.50 CSCL 01A (Declassified)

The results indicated that the addition of the small vertical tail resulted in a directionally stable configuration for angles of attack up to at least 11°. Use of a vertical tail with a 33 percent greater exposed area increased the directional-stability contribution of the vertical tail by approximately 15 to 20 percent throughout most of the Mach number range. The effective dihedral was generally positive for the configuration with the large vertical tail. The addition of a ventral fin to the configuration produced no noticeable change in the lateral and directional derivatives. At an angle of attack of 0°, the directional-stability contribution of the horizontal tail was generally from 39 to 49 percent of the stability contribution of the small vertical tail. This directional-stability contribution decreased with increasing angle of attack. The −30° dihedral angle of the horizontal tail produced a large negative increment in the effective dihedral. A rapid increase in pitching-moment coefficient with increasing angle of sideslip was produced by the combined effects of horizontal-tail negative dihedral, high wing position, and low horizontal-tail position. Author

N66-20130*# Boeing Co., Renton, Wash. Airplane Div.
SUMMARY DESCRIPTION OF A METHOD OF OPTIMIZING CAMBER SURFACES FOR WING-BODY COMBINATIONS AT SUPERSONIC SPEEDS
Oct. 1965 17 p refs
(Contract NAS2-2282)
(NASA-CR-71194; D6-10740) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A study was conducted to extend the capability of a digital computer program developed for computing the supersonic influence of wing-body interactions. The resulting program is capable of analyzing given configurations to determine pressures on the wing and body and to integrate these pressures to determine the corresponding aerodynamic forces and moments. The program also optimizes the wing camber surface to minimize drag, with the body shape specified and with constrained lift and pitching moment. The method is programmed in Fortran IV for solution on an IBM 7040.7090 computer system. Extensive geometric processing is included in the program to minimize the amount of preliminary work necessary to prepare a problem for solution. Several sample cases are documented for illustrating program use and for comparison with other theories and experimental data to validate the accuracy of the method. R.N.A.

N66-20153# Naval Ordnance Test Station, China Lake, Calif.
SLENDER-AIRFOIL CAMBERLINES WITH POLYGONAL LIFT DISTRIBUTIONS
M. L. Sturgeon Jan. 1966 28 p ref
(NAVWEPS-8999; NOTS-TP-3970; AD-627065) CFSTI: HC $2.00/MF $0.50

Nondimensional equations are developed from slender-airfoil theory to determine the geometry and pressure characteristics of a mean line camber that will enable a thin lifting surface to develop an arbitrary, assigned, polygonally shaped lift distribution in two-dimensional inviscid flow. These equations are verified as being adequate for making design decisions. Author (TAB)

N66-20182# David Taylor Model Basin, Washington, D. C.
LEADING-EDGES TO REDUCE THE DRAG OF THICK WINGS AT SUPERSONIC SPEEDS AND TO INCREASE LIFT AT LOW SPEEDS
Richard M. Hartley, Roger J. Furey, and Robert P. Letendre, Jr. Aug. 1965 36 p refs
(DTMB-2102; DTMB-AERO-1094; AD-626655) CFSTI: HC $2.00/MF $0.50

An unswept 12-percent-thick wing panel (NACA 0012 section) was tested with a wedge protruding from the blunt leading edge to determine if wing drag could be reduced and lift-to-drag ratio improved at a supersonic airspeed (Mach number 1.87). The wing and wedge were also tested at low subsonic airspeeds to determine if a slat effect existed which would increase maximum lift. At the supersonic airspeed, the wedge reduced the drag of the plain wing by as much as 29 percent at low angles of attack. At higher angles, this drag reduction vanished but the wedge still increased the maximum ratio of lift to drag by as much as 20 percent. At low speeds, a wedge slat increased maximum lift by as much as 54 percent. A small cambered airfoil slat (with a somewhat larger chord than the wedge) was able to increase maximum lift by 72 percent. Author (TAB)

N66-20208# Rome Univ. (Italy). Center of Aerospace Research.

EVALUATION OF THE AERODYNAMIC CHARACTERISTICS FOR VISCOUS INTERACTION [VALUTAZIONE DELLE CARATTERISTICHE AERODINAMICHE IN REGIME DI INTERAZIONE VISCOSA]

Ugo Ponzi and Massimo Trella Oct. 1965 40 p refs In ITALIAN; ENGLISH summary
CFSTI: HC $2.00/MF $0.50

An approximation method, based on the application of local similitude, was modified to determine the aerodynamic characteristics of hypersonic lifting body reentry vehicles and aerospace planes in regimes of viscous interactions. Emphasis was placed on a study of the flow over the upper surface of the wing. The limits of validity for the method were examined in relation to wall slip and transition toward the viscous shock layer. The results were compared with experimental data for flat plates at high Mach numbers; in addition, numerical results were obtained for various angles of attack and conical flare. It is pointed out that the method gives an adequate calculation of the aerodynamic characteristics, and furnishes the criteria for geometrical optimization. Transl. by D. T.

N66-20245# Sandia Corp., Albuquerque, N. Mex.

BASE AND SURFACE PRESSURE VARIATION WITH MACH NUMBER ON A RIGHT CIRCULAR CONE

James D. Iversen 12 Sep. 1956 16 p refs
(Contract AT(29-1)-789)
(SC-TM-202-56-51) CFSTI: HC $1.00/MF $0.50

Wind-tunnel test results and theoretical and empirical methods are used to determine the surface and base static pressure on a 30° included-angle right circular cone and the variation of that pressure with Mach number and location on the cone. The results are used to determine a combination of pressure port locations which gives a ratio of measured pressure to ambient pressure that does not vary with Mach number. A combination of base pressure and surface pressure that gives this constant ratio within desired limits is suggested. Author (NSA)

N66-20566# Office of Naval Intelligence, Washington, D. C. Translations Section.

FLYING CROSS-COUNTRY VEHICLE

N. I. Nikolayev [1963] 118 p refs Transl. into ENGLISH of the publ. "Letayushchiy Vezdekhod" Moscow, Military Publishing House of the Min. of Defense of the USSR, 1963 103 p
(ONI-TRANS-1068; AD-627252) CFSTI: HC $1.00/MF $0.75

The pamphlet based on material published in the Western press, describes the principle of flight on an air cushion, classifies the various types of craft and explains the basic theory, to permit a rough determination of basic characteristics of these machines to be made and to compare them with other means of transportation. The pamphlet also presents some schematic views and descriptions of some of the completed machines. The pamphlet is written for the information of a wide circle of readers interested in the evolution of air, marine and land transportation and acquainted with mechanics and mathematics of the intermediate school level. TAB

N66-20639# Tulane Univ., New Orleans, La. Dept. of Mechanical Engineering.

A FLOW MODEL AND ANALYSIS OF A ROCKET PAIR IN CLOSE PROXIMITY

Hugh A. Thompson and Henry F. Hrubecky Jan. 1965 39 p refs Sponsored by the Army
(AD-625566) CFSTI: HC $2.00/MF $0.50

In the flight of a pair of rockets or the salvo firing of several rockets, the trailing ones may be deflected toward the trajectory of the leading rocket. The progress that has been made in investigating the aerodynamic aspects of this problem are presented in this report. Two areas in the flow field have been isolated as regions in which an aerodynamic interaction could occur between rockets. A mathematical model has been developed which simulates the simpler of these regions: the perturbation of an inviscid, incompressible flow field by the passage of the leading rocket and the subsequent flight through this disturbed flow by the trailing rocket. This model employs a numerical method known as the method of successive overrelaxations to compute the resultant of the aerodynamic pressure force and the point at which it is concentrated for both a leading and a trailing rocket. The data that are required by the model and the problem areas that remain in the preparation of these data are presented and discussed. Author (TAB)

N66-20653# National Aero- and Aeronautical Research Inst., Amsterdam (Netherlands).

TUNNEL WALL CORRECTIONS FOR A WING-FLAP SYSTEM BETWEEN TWO PARALLEL WALLS

E. M. de Jager and A. I. van de Vooren Jun. 1965 26 p refs Submitted for Publication
(NLR-TR-W.7) CFSTI: HC $2.00/MF $0.50

A method is presented for the calculation of the corrections due to the tunnel walls, to be applied to the measured lift and moment of a two-dimensional wing flap model between two parallel walls. The theory developed here is non-linearized since the angle of flap deflection may be large. Calculations have been performed for three values of the ratio of wing to flap chord, for three values of the ratio of wing chord to tunnel height and for angles of flap deflection up to 75°. Author

N66-20665# Aeronautical Research Inst. of Sweden, Stockholm.

LAMINAR SEPARATION AND REATTACHMENT BEHIND A DOWNSTREAM FACING STEP AT HYPERSONIC MACH NUMBER, INCLUDING THE EFFECTS OF THE APPROACHING BOUNDARY LAYER

Robert A. White May 1965 28 p refs
(FFA-103) CFSTI: HC $2.00/MF $0.50

The use of integral methods and the so-called equivalent mass bleed concept which has proven so successful in treating the turbulent mixing problem for separated flows with finite

approaching boundary layers has been adapted to the laminar case. Utilizing the fully developed laminar mixing velocity profiles of Chapman, the necessary integrals have been computed for isoenergetic flow with external Mach numbers up to ten. Experiments at Mach number of seven have been performed to check the results of the analysis. Excellent qualitative and good quantitative agreement was obtained for base pressure predictions over a wide range of the parameter $\delta^{**}\sqrt{Re_x}/t$ which represents the effects of changing step height and approaching boundary layer. The base pressure was found to change by a factor of 3 for a variation of $\delta^{**}\sqrt{Re_x}/t$ from two to thirty. The line of flow reversal at reattachment was found to occur at about one half the total reattachment pressure rise. Boundary layer displacement effects on the induced pressure before separation have been found to persist downstream through the reattachment process and to affect the base pressure. Author

N66-20671# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE EFFECT OF PROPULSIVE JET SPECIFIC HEAT RATIO ON BASE PRESSURE AT A FREESTREAM MACH NUMBER OF 2.18
H. Ginsberg Aug. 1965 28 p refs
(Contract NOw-62-0604-c)
(TG-718; AD-626301) CFSTI: HC $2.00/MF $0.50

The report documents studies to determine experimentally the effect of thrusting-jet specific heat ratios on missile model base pressure. The tests were conducted at a freestream Mach number of 2.18 over a wide range of jet static to freestream static pressure ratios. Variation of the specific heat ratios was obtained by the use of different jet gases. Jet static pressure ratios up to 40 have been covered. Flow interference effects were held to a minimum by mounting the model on a support attached to a strut in the plenum chamber of the wind tunnel and reaching through the wind tunnel nozzle throat into the test section. The effects of molecular weight (at $\gamma = 1.66$) on base pressure were briefly investigated. A molecular weight shift from 40 to 29 showed only a slight effect on base pressure, however, a shift from 29 to 4 increased the base pressure coefficient an average of 0.04 or approximately 20% of the minimum value at a freestream-to-jet molecular weight ratio of unity for all jet static pressure ratios tested. Extension areas recommended for further investigation include the determination of jet-specific-heat ratio, jet temperature and molecular-weight effects on base pressure when freestream conditions and model afterbody geometry are systematically varied. Author (TAB)

N66-20826# Boeing Co., Morton, Pa. Vertol Div.
DESIGN AND WIND TUNNEL TEST OF A MODEL HELICOPTER ROTOR HAVING AN INDEPENDENTLY MOVABLE INBOARD BLADE PANEL Final Report
D. G. Ekquist Ft. Eustis, Va., Army Aviation Materiel Labs., Oct. 1965 102 p refs
(Contract DA-44-177-AMC-129(T))
(R-420; USAAVLABS-TR-65-63; AD-623129) CFSTI: HC $4.00/MF $0.75

Wind tunnel tests of a rotor having an independently movable inboard blade panel were conducted at an advance ratio of 0.6. It was demonstrated that this design resulted in a major advance in propulsive capability over the conventional type of rotor. Test results are presented in nondimensional plots of lift, power, and propulsive force versus control axis angle, and in cross-plotted contours of constant power of lift versus propulsive force axes. Author (TAB)

N66-20852# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
AIR LOADINGS ON A ROTOR BLADE AS CAUSED BY TRANSIENT INPUTS OF COLLECTIVE PITCH Final Report, Sep. 1963–May 1965
Leonard Segel Oct. 1965 86 p refs
(Contract DA-44-177-AMC-77(T))
(CAL-BB-1840-S-1; USAAVLABS-TR-65-65; AD-624860)
CFSTI: HC $3.00/MF $0.75

A method is developed for predicting the nonperiodic air loads caused by control inputs applied to a rotary wing in forward flight. Use is made of a numerical description of the geometry and circulation strength of the vorticity in the wake to compute the time-varying, nonuniform-flow field in the plane of the rotor disc. The method of approach is similar to that developed previously for the steadystate flight condition, the major difference being that the solution procedure lends itself to the treatment of transient phenomena, such as the nonperiodic loadings caused by time-varying collective pitch. Several approximations are made to simplify the analysis. The major assumptions are: (1) the rotor blades are structurally rigid and have only a flapping degree of freedom; (2) the hub of the rotor continues to translate in level, constant-speed flight during the short time interval of interest; (3) the geometry of the wake can be specified a priori; and (4) no account need be taken of the shed vorticity in the wake. Computed flapping and air load distributions are compared with transient data obtained in wind-tunnel tests on a full-scale H-34 rotor. In general, agreement is found leading to the conclusion that calculation and prediction of nonperiodic loadings on rotary wings is a feasible task. Author (TAB)

N66-20853# Aerodynamische Versuchsanstalt, Gottingen (West Germany). Abteilung Aerodynamik.
TURBULENT BOUNDARY LAYER STUDIES ON A WAISTED BODY OF REVOLUTION IN SUBSONIC AND SUPERSONIC FLOW [UNTERSUCHUNGEN DER TURBULENTEN GRENZSCHICHT AN EINEM TAILLIERTEN DREHKORPER BEI UNTER- UND UEBERSCHALLSTROMUNG]
J. C. Rotta, K. G. Winter, and K. G. Smith (Roy. Aircraft Estab., Bedford, England) Nov. 1965 89 p refs In GERMAN; ENGLISH and FRENCH summaries Presented at AGARD Conf. on Recent Develop. in Boundary Layer Res., Naples, 10–14 May 1965 Also published in AGARDograph-97 p 933–981
(AVA-FB-65-09; DLR-FB-65-52) CFSTI: HC $3.00/MF $0.75

The effect of Mach number, pressure gradient as well as convergence and divergence of streamlines on the development of the turbulent boundary layer has been studied. Pressure distributions, local skin friction coefficients, and boundary layer velocity profiles have been determined experimentally at Mach numbers ranging from 0.6 to 2.8. Calculations have been made, the basis of which is simultaneous integration along the body of the momentum and kinetic energy equations of the boundary layer. The results of the tests and calculations agree with respect to the general development of displacement, momentum and kinetic energy thickness as well as skin friction coefficient. In the attempt to explain the observed differences, it was found that the surface curvature has a considerable effect on the development of the turbulent boundary layer at supersonic flow. Author

N66-20899*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS IN PITCH, INCLUDING EFFECTS OF HORIZONTAL-TAIL NEGATIVE DIHEDRAL ANGLE, OF A 0.048-SCALE MODEL OF A HORIZONTAL-ATTITUDE VTOL AIRPLANE AT TRANSONIC SPEEDS

Walter B. Olstad Washington, NASA, Oct. 1960 55 p refs
(NASA-TM-X-11) CFSTI: HC $3.00/MF $0.50 CSCL 01A
(Declassified)

An investigation was made of the aerodynamic characteristics in pitch of a 0.048-scale model of a horizontal-attitude vertical-take-off-and-landing (VTOL) airplane at Mach numbers from 0.60 to 1.20 and at angles of attack up to 25°. The effects of horizontal-tail negative dihedral and a modification to the fuselage indentation were also studied. The results indicated that the configuration with the 0° dihedral horizontal tail was statically unstable at zero lift for test Mach numbers from 0.60 to 1.05. Decreasing the horizontal-tail dihedral angle increased the static stability of the model. The configuration with the −30° dihedral horizontal tail was statically stable throughout the Mach number range of the investigation although it approached a condition of neutral stability at a Mach number of 0.90. The modification to the fuselage indentation of the model permitted an increase in useful volume without incurring a large drag penalty. Author

N66-20900*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS OF PRESSURE DISTRIBUTIONS FOR A SERIES OF TIP AND TRAILING-EDGE CONTROLS ON A 60° WING AT MACH NUMBERS OF 1.61 AND 2.01
Douglas R. Lord and K. R. Czarnecki Washington, NACA, 16 May 1958 48 p refs
(NACA-RM-L58C07) CFSTI: HC $6.00/MF $1.50 CSCL 01A
(Declassified)

An investigation has been made at Mach numbers of 1.61 and 2.01 and at Reynolds numbers from 1.7×10^6 to 7.6×10^6 to determine the pressure distributions for a series of 20 controls on a 60° delta wing. Thirteen of the controls were of the balanced tip type and seven of the controls were of the more conventional trailing-edge type. Tests were made at wing angles of attack from 0° to 15° for control deflections from −30° to 30°. At small angular conditions, the pressure changes due to increasing the Mach number were in agreement with theory. Increasing the Reynolds number caused negligible changes in the pressure distributions. Hinge-line movement or parting-line fences on the tip-type controls resulted in sizeable changes in the pressure distributions near the parting lines because of the strong crossflow in these regions. Author

N66-20901*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS IN PITCH AT A MACH NUMBER OF 1.97 OF TWO VARIABLE-WING-SWEEP V/STOL CONFIGURATIONS WITH OUTBOARD WING PANELS SWEPT BACK 75°
Gerald V. Foster and Odell A. Morris Washington, NASA, Oct. 1960 28 p refs
(NASA-TM-X-322) CFSTI: HC $2.00/MF $0.50 CSCL 01A
(Declassified)

An investigation has been conducted in the Langley 4- by 4-foot supersonic pressure tunnel at a Mach number of 1.97 to determine the aerodynamic characteristics in pitch of two variable-wing-sweep V/STOL configurations with the outboard wing panels swept back 75°. The results show a linear variation of pitching moment with lift coefficient for both models tested. These results, in conjunction with results for the same models at subsonic and transonic speeds indicate that the total change in static margin due to increasing the Mach number and changing the wing sweep from 25° to 75° is about 13 percent of the mean geometric chord. The maximum untrimmed lift-drag ratios for the complete configurations were 4.20 for model 1 and 3.75 for model 2. Author

N66-20902*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF THE TRANSONIC AND SUPERSONIC FLUTTER CHARACTERISTICS OF THE UPPER AND LOWER VERTICAL TAILS OF AN AIR-TO-GROUND MISSILE
Perry W. Hanson and A. Gerald Rainey Washington, NACA, 5 Jun. 1957 32 p refs
(NACA-RM-L57D17) CFSTI: HC $2.00/MF $0.50 CSCL 01A
(Declassified)

Flutter models of the upper and lower vertical tails of an air-to-ground missile have been tested in the Mach number range from 0.5 to 3.0. It was found that the upper surface exhibited more or less conventional flutter behavior throughout the Mach number range, whereas the lower surface experienced a sudden change in flutter mode at a Mach number of about 1.18. This change in flutter mode was accompanied by a decrease of about 50 percent in the density required for flutter to occur. Author

N66-20920# Aeronautical Research Labs., Melbourne (Australia).
SOME OBSERVATIONS OF THE LOW-SPEED FLOW OVER A SHARP-EDGED DELTA WING OF UNIT ASPECT RATIO
D. A. Lemaire Jan. 1965 97 p refs
(ARL/A-126) CFSTI: HC $3.00/MF $0.75

An investigation has been made into the low speed surface flow characteristics of a sharp-edged delta wing of unit aspect ratio. Data provided by balance measurements of longitudinal force and moment, surface pressure measurements, visualization of surface flow, and boundary-layer measurements using a hot-wire anemometer have been correlated. Spanwise pressure distributions measured over the forward part of the wing have shown considerable variation with Reynolds' number in the test range $R_o=1.6\times10^6$ to 6.4×10^6 (R_o based on root chord). This variation is shown to correspond with changes in the mode of breakdown of the region of laminar boundary of layer flow which is produced under the core of the leading edge vortex. Author

N66-20928*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FURTHER INVESTIGATION OF EFFECT OF AIR INJECTION THROUGH SLOTS AND POROUS SURFACES ON FLAT-PLATE TURBULENT SKIN FRICTION AT MACH 3
John B. Peterson, Jr., Donald I. Mc Ree, Jerry B. Adcock, and Albert L. Braslow Washington, NASA, Mar. 1966 78 p refs
(NASA-TN-D-3311) CFSTI: HC $0.95/MF $0.75 CSCL 01A

An investigation was made at a Mach number of 3 and a Reynolds number per foot of 9.75×10^6 of the effectiveness of injection of air into the turbulent boundary layer through partial-chord porous surfaces, multiple normal flush slots, and rearward inclined flush and step slots in reducing the level of supersonic skin friction. The local and average skin friction near the end of the flat plate are presented for each configuration. In addition, boundary layer velocity profiles and average skin friction coefficients were measured at various positions behind the last point of injection. The results of the partial-chord porous injection configurations and the three normal flush slot configuration show that they are about as effective as the full-chord porous configuration. The 0.018-inch wide rearward inclined flush slot was more effective than any of the new

slot configurations. The velocity profiles measured behind this slot indicated that most of the skin friction reduction took place close behind the point of injection. The effectiveness of the various slot configurations appears to be largely dependent on the manner in which the injected air mixed with the original boundary layer. Author

N66-21017*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
STUDY OF FLOW FIELDS ABOUT AXISYMMETRIC BLUNT BODIES AT LARGE ANGLE-OF-ATTACK Summary Report, Jul. 1964–Nov. 1965
29 Oct. 1965 16 p refs
(Contract NAS9-3159)
(NASA-CR-65297; SID-65-1354) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A computer program was used to compute equations describing the inviscid flow of equilibrium real gas over blunt axisymmetric bodies at large angles-of-attack traveling at supersonic speed. The solution was obtained using finite difference methods, and an analytical expression for the detached shock wave is given. Flow fields were developed for four blunt body shapes: a sphere, a spherically blunted cone-cylinder, an Apollo shape, and a Gemini shape. The flight conditions used for each of the cases are shown in a table. The results obtained with the program appear to agree quite well with other available published theoretical information. In addition, flow patterns on the Apollo and Gemini surfaces appear consistent with published experimental oil flow data. L.S.

N66-21028*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY OF THE PRESSURE, HEAT TRANSFER, AND SKIN FRICTION ON SHARP AND BLUNT FLAT PLATES AT MACH 6.8
Luther Neal, Jr. Washington, NASA, Apr. 1966 58 p refs
(NASA-TN-D-3312) CFSTI: HC $0.85/MF $0.50 CSCL 01A

The results showed no significant effect on the pressure distribution of a sixfold change in Reynolds number for the 1.27-cm-thick leading edge for surface distances up to about 20 times the leading-edge thicknesss. However, for the 0.25-cm-thick leading edge, viscous effects were obtained which were roughly of the same order of magnitude as those found for the "sharp" (0.0025 cm thick) leading edge. The agreement between theoretical and experimental pressures could generally be classified as fair to good for the particular theories employed. Comparison of the laminar and turbulent skin-friction and heat-transfer data with corresponding theoretical estimates showed both agreement and disagreement, depending, among other things, upon the leading-edge thickness, the particular theory used, and for the turbulent data, the position used for the virtual origin. Small and moderate leading-edge blunting delayed transition whereas the largest blunting produced about the same transition Reynolds number as the sharp leading edge. Also, for the sharp leading edge, good agreement between measured skin-friction and heat-transfer results was obtained, for both laminar and turbulent flow, with use of particular forms of the Reynolds analogy. Author

N66-21029*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEWTONIAN AERODYNAMICS FOR TANGENT OGIVE BODIES OF REVOLUTION
Edward E. Mayo Washington, NASA, Mar. 1966 25 p refs
(NASA-TN-D-3337) CFSTI: HC $0.35/MF $0.50 CSCL 01A

Aerodynamic coefficients and static stability characteristics of tangent ogive bodies of revolution are presented. The body fineness ratio varied from 0.5 (a hemisphere) to a fineness of 7 and the angle of attack ranged from 0 to 180°. Author

N66-21040*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL SOLUTIONS FOR BLUNT AXISYMMETRIC BODIES IN A SUPERSONIC SPHERICAL SOURCE FLOW
Mamoru Inouye Washington, NASA, Apr. 1966 37 p refs
(NASA-TN-D-3383) CFSTI: HC $0.55/MF $0.50 CSCL 01A

The effect of spherical source flow about blunt-nosed axisymmetric bodies has been studied by solving numerically the inviscid equations of motion. An inverse method is used in the subsonic-transonic region, and the method of characteristics is used in the supersonic region. The fluid may be a perfect gas or a real gas in thermodynamic equilibrium. Solutions have been obtained for spherical-nosed bodies in perfect gas flow to demonstrate the effects of source flow in terms of a parameter defined as the ratio of the nose radius of curvature to the distance between the nose and source. In the nose region, the increase in stagnation-point velocity gradient and decrease in shock standoff distance and surface pressure away from the stagnation point are of the same order of magnitude as the source flow parameter. Over the afterbody of a hemisphere cylinder and a blunted 15° cone, the reductions in surface pressure and outward displacement of the shock are an order of magnitude larger than the source flow parameter. For a blunted 30° cone, the reductions in surface pressure are similarly significant, but the changes in the shock configuration are small. Author

N66-21043*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF THE DIVERGENCE CHARACTERISTICS OF DELTA-PLANFORM CANARD CONTROLS
A. Gerald Rainey, Perry W. Hanson, and Dennis J. Martin Washington, NASA, Apr. 1966 34 p refs
(NASA-TR-R-235) CFSTI: HC $0.50/MF $0.50 CSCL01A

The static aeroelastic divergence characteristics of a delta-planform model of a canard control surface have been studied both analytically and experimentally in the Mach number range from 0.6 to 3.0. The experiments indicated that divergence occurred at a nearly constant value of dynamic pressure at Mach numbers up to 1.2. At higher Mach numbers somewhat higher values of dynamic pressure were required to produce divergence. The analysis and the experiment indicate that the camber stiffness of the control surface and the stiffness of the control actuator are both important in divergence of surfaces of this type. Author

N66-21102# Naval Ordnance Lab., White Oak, Md.
STABILITY AND DRAG OF A MODIFIED SATURN/APOLLO SECOND-STAGE CONFIGURATION IN THE NOL PRESSURIVED BALLISTICS RANGE Final Test Report
David N. Bixler and Stuart L. Hanlein Mar. 1966 22 p ref
/ts Ballistics Res. Rept.-146
(NOLTR-65-122; AD-627663) CFSTI: HC $1.00/MF $0.50

Thirty launchings of models of a modified Saturn/Apollo second-stage configuration were performed. The purpose of the launchings was to obtain stability and drag coefficients in a realm of Mach numbers from 4 to 8 and ambient air pressures from 6.3 to 928 mm Hg. Author (TAB)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-19797# Aeronautical Research Labs., Melbourne (Australia). Dept. of Supply.

LOW SPEED WIND TUNNEL TESTS OF THE VICTA AIRCRUISER 180

W. H. Melbourne Jan. 1965 46 p refs

(ARL/A-235) CFSTI: HC $2.00/MF $0.50

An investigation of the prototype design of the single engined, four passenger, Victa Aircruiser 180 has been made in the 9'×7' low speed wind tunnel. The investigation included a visual study (with wool tufts) of the stalling characteristics and regions of flow separation through a range of pitch, yaw and control angles. This resulted in several minor modifications being made to the shape. With the model in the revised configuration forces and moments were measured to derive the longitudinal, lateral and control static derivatives. It was concluded that the stalling characteristics of the design are satisfactory and that adequate stability and control power is available for the estimated center of gravity limits. Author

N66-19880# Lockheed-California Co., Burbank.

THE LOCKHEED L-2000 SUPERSONIC TRANSPORT. A DESIGN REPORT UPON CHARACTERISTICS AFFECTING MAINTENANCE

John F. Mc Donald [1965] 67 p refs Presented at the Ann. Maintenance and Eng. Meeting of the Air Transport Assoc. of Am., Miami Beach, Fla., Oct. 1965

Some of the fundamental differences between a supersonic transport and current subsonic jet transports are examined in order to provide a background for assessing the probable maintenance characteristics of this coming generation of aircraft. It is shown that physical and system design arrangements of the aircraft are markedly different and some reasons are outlined for the more significant changes. The propulsion system and airframe structure are considered in some detail while important departures in functional systems such as environmental control, flight control, fuel, hydraulics and electrical are also examined. Comments are included on material technology limitations as they exist today. Observations are made upon ground servicing aspects, and the design techniques for ensuring proper attention to maintenance and overhaul are discussed. A comprehensive list of references is also provided. Author

N66-19912# Republic Aviation Corp., Farmingdale, N. Y.

FEASIBILITY STUDY ON THE DESIGN AND DEVELOPMENT OF A VTOL BLAST CONTROLLING PLATFORM Technical Report, 1 Apr.-25 Aug. 1965

S. Bartha and F. H. Ringler Aug. 1965 87 p *Its* Rept.-3-123 (Contract DA-22-079-ENG-435)

(C-6091-05; AD-626617) CFSTI: HC $3.00/MF $0.75

A concept was developed for a portable vertical take-off and landing blast diverting platform which would direct the exhaust blast away from the aircraft and into the air to prevent terrain erosion, hot gas reingestion, ground effects, and signature. The platform would be assembled on site from modular sections, each section containing deflector vanes and topped by a load bearing grid. The feasibility of this concept has been demonstrated by scale model testing. The results indicate that such a platform is efficient in conducting engine exhaust blast and accompanying entrained air away from the aircraft. Significant reduction in thrust loss and lower surface temperature on the aircraft model were observed. Author (TAB)

N66-19933# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).

AIR FLIGHT TECHNOLOGY—SURVEY OF LITERATURE [LUCHTVAARTTECHNIEK LITERATUUROVERZICHT]

26 Jan. 1966 33 p refs In DUTCH, FRENCH, ENGLISH, and GERMAN *Its* Vol. 14, No. L-290 CFSTI: HC $1.00/MF $0.50

Abstracts and bibliographic notes are included on the topics of model descriptions, airplane properties and achievements, propulsion, board systems and instruments, steering, airports, navigation and air traffic control, safety, aerodynamics, strength and vibration research, air cushion vehicles, helicopter problems, and bird-impact testing. Transl. by J.O.

N66-20161# David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.

SEAWORTHINESS CHARACTERISTICS OF A GROUND EFFECT MACHINE OBTAINED FROM MODEL TESTS OVER REGULAR WAVES Final Report

Alvin Gersten and Joseph M. Sheehan Dec. 1965 34 p refs

(DTMB-2034; AD-627250) CFSTI: HC $2.00/MF $0.50

A model representing a ground effect machine (GEM) designed by the Bureau of Ships for overwater operation was towed over regular waves allowing freedom in pitch and heave. The tests were conducted with the craft traveling in following seas. Measurements were made of the resulting motions, drag forces, and accelerations. The data reveal that at speeds up to 40 knots, the pitching motion per unit wave height of the GEM is generally more severe than that experienced by conventional small craft and large ocean going ships. The heaving motion per unit wave height of the GEM is also greater than the characteristic heaving motion of more conventional vessels. It was also determined that pitch and heave motions and surge force are linearly related to wave height throughout the range utilized in these tests. Wave steepnesses as great as 1/32 were investigated. Author (TAB)

N66-20800# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

METHOD FOR THE DETERMINATION OF THE NOISE FROM TURBOJET AIRCRAFT ON TAKEOFF TRAJECTORIES [METHODE DE CALCUL DE BRUIT PRODUIT PAR DES AVIONS A REACTION SUR LEUR TRAJECTOIRE DE DECOLLAGE]

Michel Kobrynski 1965 75 p refs In FRENCH; ENGLISH summary

(ONERA-TN-81) CFSTI: HC $3.00/MF $0.75

The approximate determination of the maximum sound pressure of turbojet aircraft on the ground or in subsonic flight may be carried out from the laws of jet noise emissions by means of the generalized spectrum of the sound pressure and of the directivity of the acoustic rays. A first method applicable when the jet Mach number is smaller than 2 (with respect to the velocity of sound in the atmosphere) takes into account the theoretical variation of the acoustic power proportional to V_j^8

with V_j as the jet velocity. If the jet is in motion such as it is the case in flight, the basic parameter is the difference $V_j - V_e$ in which V_e represents the aircraft velocity. In the second method the eddy convection Mach number M_c and also, when necessary, the Aircraft Mach Number M, are taken into account in the form of a correction factor

$$\left[1-\left(M_c-\frac{M}{2}\right)\cos\theta_M\right]^{-n}\left(1+M\cos\theta_M\right)^{-5}$$

with exponent n and the emission angle θ_M of the maximum acoustic radiation being both function of M_c. This method is applicable for the pre-determination of the noise of future airplanes such as Concorde, the jet Mach number of which, relative to the atmospheric speed of sound, would be in the order of 2.5. Author

N66-20858# Lockheed-California Co., Burbank.
EXTENSION OF THE HIGH-SPEED FLIGHT ENVELOPE OF THE XH-51A COMPOUND HELICOPTER Final Report, 10 Apr.–25 May 1965
Donald R. Wyrick Nov. 1965 72 p refs
(Contract DA-44-177-AMC-150(T))
(LR-18917; USAAVLABS-TR-65-71; AD-627372) CFSTI: HC $3.00/MF $0.75

The report presents the results of a speed extension program on the compound version of the rigid-rotor XH-51A helicopter. The principle objective of the program was to investigate the flight characteristics of the compound helicopter with special emphasis on the areas of flying qualities, performance, structural loads, vibration, and maneuverability in the speed range of 200 to 230 knots true airspeed. All contract objectives were met or exceeded. The maximum level flight true airspeeds demonstrated, during this program, were 236 knots at sea level and 228 knots at a density altitude of 12,000 feet. Author (TAB)

N66-20862# Kaman Aircraft Corp., Bloomfield, Conn. Electronic Systems Div.
A STUDY OF REQUIREMENTS FOR ENGINE FAILURE PROTECTIVE WARNING SYSTEMS IN SINGLE-ENGINE TURBINE HELICOPTERS Final Report
Lawrence A. Kaufman and James L. Van Train Nov. 1965 96 p refs
(Contract DA-44-177-AMC-155(T))
(R-565; USAAVLABS-TR-65-55; AD-627369) CFSTI: HC $3.00/MF $0.75

A study was made to evaluate recovery techniques associated with loss of power in single engine helicopters throughout the flight envelopes currently attainable in actual Army missions. The report includes detailed mission profile analyses, helicopter dynamic analysis, and considerations of system design factors. It is concluded that redundant warning of power plant failures is feasible and desirable but that automatic actuation following failure is impractical and unnecessary. Author (TAB)

N66-20863# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
AN ANALYTICAL STUDY OF THE DYNAMICS OF AIRCRAFT IN UNSTEADY FLIGHT
H. C. Curtiss, Jr. Oct. 1965 234 p refs *Its* Rept.-709
(Contract DA-44-177-AMC-8(T))
(USAAVLABS-TR-65-48; AD-627370)

The dynamic response of conventional and VTOL aircraft with varying flight velocity is investigated. It is assumed that the dynamic motions of aircraft may be described by linear differential equations whose coefficients (stability derivatives) are functions of flight velocity, and therefore vary with time. Primary emphasis is placed on the evaluation of the general nature of the vehicle response and its departure from frozen system (constant coefficients) characteristics. TAB

N66-21022# Advisory Group for Aerospace Research and Development, Paris (France).
SHORTENING THE TAKEOFF AND LANDING DISTANCES OF HIGH SPEED AIRCRAFT
John K. Wimpress (Boeing Co., Reston, Wash.) Jun. 1965 32 p Presented at 26th Meeting of the AGARD Flight Mech. Panel, Paris, Jun. 1965
(AGARD-501) CFSTI: HC $2.00/MF $0.50

This paper examines some of the fundamental relationships involved in shortening the takeoff and landing distances of high speed aircraft. First, a review is made of the fundamental parameters that determine takeoff and landing distance with particular emphasis on the influence of lift coefficient (C_L), lift-to-drag ratio (L/D), and thrust-to-weight ratio (T/W). Second, since lift coefficients are so vital to field length performance, recent developments in high lift systems are presented. Third, the results of fitting various high-lift systems into the field length requirements of transport and STOL aircraft are discussed. The objective of the paper is to demonstrate some of the compromises that must be made to achieve short field lengths and to point out areas where further work in aerodynamics and propulsion systems may be fruitful. Author

N66-21023# Advisory Group for Aerospace Research and Development, Paris (France).
FLIGHT DEVELOPMENT OF A HIGH LIFT RESEARCH AIRCRAFT USING DISTRIBUTED SUCTION
D. G. Clark Jun. 1965 34 p refs Presented at 26th Meeting of the AGARD Flight Mech. Panel, Paris, Jun. 1965
(AGARD-502) CFSTI: HC $2.00/MF $0.50

A modified, single-engined light aircraft, intended for research flying, and fitted with means for applying distributed suction to the wing upper surface, has been flown at lift coefficients in excess of 5.0. In order to overcome deficiencies in the suction system, a new leading edge contour, which greatly reduced the peak suction pressures required, was developed for the wing section. With flaps undeflected and suction applied, the original section yielded an overall lift coefficient of 3.2, and a section lift coefficient of 3.0 based on measured pressure distributions. With the modified leading edge, a section lift coefficient of 3.9 has been obtained. The stalling angle of attack, flaps up, has risen to 42°, but the stalling behaviour remains mild. Suction applied to the flap knee only was effective in reducing the angle of attack at lift coefficients previously attainable, but did not increase the stalling lift coefficient. No difficulties due to blockage of the suction surface with dirt or dust have been experienced. Author

N66-21024# Advisory Group For Aerospace Research and Development, Paris (France).
STABILITY AND CONTROL CONSIDERATIONS FOR STOL AIRCRAFT
Seth B. Anderson, Hervey C. Quigley, and Robert C. Innis (NASA. Ames Res. Center) June 1965 48 p refs Presented at 26th Meeting of the AGARD Flight Mech. Panel, Paris, Jun. 1965
(AGARD-504) CFSTI: HC $2.00/MF $0.50

Studies of a number of STOL aircraft show that relatively high maximum lift-coefficients and large increases in lift due to power are within the present state of the art. With these lift characteristics, approach speeds of the order of 60 knots for aircraft of moderate wing loading can be realized. Full advantage of the STOL performance of aircraft such as those discussed herein may not be realized on a routine operational basis, however, without some form of damping augmentation system because of lateral-directional handling considerations, particularly for large aircraft operating under instrument flight conditions. Satisfactory characteristics can be obtained by use of only a servodriven rudder. Additional experience is needed to determine how the STOL aircraft is to be operated before more firm requirements for augmentation systems can be established. Author

N66-21025# Advisory Group for Aerospace Research and Development, Paris (France).
DETERMINATION OF TAKE-OFF AND LANDING DATA WITH AN AIRBORNE FORWARD-LOOKING CAMERA COMBINED WITH ACCELEROMETERS
J. P. K. Vleghert Jun. 1965 40 p refs Presented at 26th Meeting of the AGARD Flight Mech. Panel, Paris, Jun. 1965
(AGARD-505) CFSTI: HC $2.00/MF $0.50

Take-off and landing data can be determined with a forward-looking camera in the airplane, which photographs the runway light 100–300 yd ahead of the airplane with a pre-set time interval. Distance, height, angle of drift, bank and pitch, and lateral displacement from the runway centerline can be calculated directly versus time, while ground speed is obtained via differentials. With a longitudinal accelerometer, and pitch reference furnished by the camera, momentary accelerating or decelerating forces on the ground can be found. For evaluation of performance during lift-off or flare-out, the addition of a normal accelerometer is necessary. Ground speed can be obtained by integration. This method can be applied with relatively inexpensive equipment on any runway with edge lighting. It has a measuring accuracy at least equal to that of conventional phototheodolites, while more data can be obtained. Synchonization is eased by the absence of ground equipment. Author

N66-21041*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
SUMMARY OF HIGH-ALTITUDE AND ENTRY FLIGHT CONTROL EXPERIENCE WITH THE X-15 AIRPLANE
Euclid C. Holleman Washington, NASA, Apr. 1966 68 p refs
(NASA-TN-D-3386) CFSTI: HC $1.00/MF $0.75 CSCL 01C

Flights to high altitude with the X-15 research airplane have successfully demonstrated that a pilot can control lifting entry into the atmosphere. Flights were made with two airplane configurations and with several types of reaction and aerodynamic controls. The pilots' performance in these flights was similar with all of the reaction control systems tested–angular acceleration, angular acceleration with damping, and rate command–and was comparable to the performance of the automatic hold systems. The pilots evaluated the reaction control task with all systems as satisfactory. For a range of altitude from 200,000 feet to 354,200 feet, the entry control task with attitude command with damping, rate command, and hold was rated satisfactory. The entry acceleration environment did not affect the pilot's performance. Neither the controllability of the entry nor the pilot's evaluation of the task was degraded by the more severe entries. Author

N66-21099*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
ANALYSIS OF AN EMERGENCY DECELERATION AND DESCENT OF THE XB-70-1 AIRPLANE DUE TO ENGINE DAMAGE RESULTING FROM STRUCTURAL FAILURE
Chester H. Wolowicz Washington, NASA, Mar. 1966 35 p refs
(NASA-TM-X-1195) CFSTI: HC $2.00/MF $0.50 CSCL 01C

An emergency on flight 12 of the XB-70-1 airplane at a Mach number of 2.6 and a pressure altitude of 63,000 feet provided unusual operational, handling qualities, and stability and control data of interest to the supersonic-transport designer. Failure of the wing apex, its ingestion into the right inlet duct, and subsequent damage to the engines produced a steadily deteriorating propulsion situation, which led to resonant vibrations in the relatively flexible fuselage and subsequent stability and control problems in attempting to deal with the vibrations. The results of an analysis of this emergency may be useful in developing adequate operational margins and procedures in the design of the supersonic transport. Author

N66-21103# Systems Technology, Inc., Hawthorne, Calif.
A STUDY OF CONVENTIONAL AIRPLANE HANDLING QUALITIES REQUIREMENTS. PART I: ROLL HANDLING QUALITIES Final Report, Jan. 1963–May 1965
Irving L. Ashkenas Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Nov. 1965 82 p refs
(Contract AF 33(657)-10407)
(AFFDL-TR-65-138, Pt. I; AD-627659) CFSTI: HC $3.00/MF $0.75

The report uses as a point of departure the concept that control of bank angle is the primary piloting task in maintaining or changing heading. Regulation of the bank angle to maintain heading is a close-loop tracking task in which the pilot applies aileron control as a function of observed bank angle error. For large heading changes, the steady-state bank angle consistent with available or desired load factor is attained in an open-loop fashion; it is then regulated in a closed-loop fashion throughout the remainder of the turn. For the transient entry and exit from the turn, the pilot is not concenred with bank angle per se, but rather with attaining a mentally commanded bank angle with tolerable accuracy in a reasonable time, and with an easily learned and comfortable program of aileron movements. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-19805# Library of Congress, Washington, D. C. Aerospace Technology Div.
ELECTROMAGNETIC AND ELECTROSTATIC GENERATORS Annotated Bibliography, 1961–Jul. 1965
Jordan V. Randjelovic 15 Nov. 1965 35 p refs Surveys of Soviet Sci. and Tech. Lit.
(ATD-65-103)

An annotated bibliography is presented of Soviet developments in electromagnetic and electrostatic generators, electric motors and machines, and associated technology. Arranged in chronological order, the data were taken from four open source journals published between 1961 and 1965. M.W.R.

N66-19946# Joint Publications Research Service, Washington, D. C.
HELIOTECHNOLOGY
28 Feb. 1966 71 p refs Transl. into ENGLISH of Geliotekhnika (Tashkent), v. 1, no. 4, 1965 p 5-61 (JPRS-34321; TT-66-30762) CFSTI: $3.00

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1. A STUDY OF SYSTEMS OF CONSTANT-POWER REGULATION OF SOLAR-FURNACE HEAT FLUX A. V. Vartanyan and Ya. T. Shermazanyan p 1-6 refs (See N66-19947 10-03)

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4. THE USE OF POLYURETHANE FOAM IN MAKING SOLAR ENERGY COLLECTORS S. N. Vil'kova, I. A. Novikova, and D. Alvutdinov p 23-26 refs (See N66-19950 10-18)

5. DETERMINING AERODYNAMIC COEFFICIENTS OF SOLAR DISTILLATION UNITS TO COMPUTE VAPOR-AIR MIXTURE LEAKAGE P. A. Dzhubaliyeva p 27-32 refs (See N66-19951 10-03)

6. THE EFFECT OF SOLAR DISTILLER CHAMBER NON-AIRTIGHTNESS ON DISTILLER TECHNICAL CHARACTERISTICS UNDER HEAT PRESSURE P. A. Dzhubaliyeva p 33-37 refs (See N66-19952 10-03)

7. SOLAR RADIATION ENTERING A HOTHOUSE P. F. Rzayev p 38-43 refs (See N66-19953 10-33)

8. A SOLAR FURNACE OF POLYETHYLENETEREPHTHALATE FILM G. Ya. Umarov and N. V. Kordub p 44-45 refs (See N66-19954 10-03)

9. HELIOTECHNOLOGICAL NEWS p 46-47 refs

10. BIBLIOGRAPHY: LITERATURE ON HELIOTECHNOLOGY FROM 1931 TO 1940 p 48-56

11. NEW LITERATURE [ABSTRACTS] p 57-60 refs

N66-19947 Joint Publications Research Service, Washington, D. C.
A STUDY OF SYSTEMS OF CONSTANT-POWER REGULATION OF SOLAR-FURNACE HEAT FLUX
A. V. Vartanyan and Ya. T. Shermazanyan *In its* Heliotechnology 28 Feb. 1966 p 1-6 refs (See N66-19946 10-03) CFSTI: $3.00

Shading geometries for collector surfaces of solar furnaces to regulate their radiation flux and achieve a stable heat field were studied. Various structured shading patterns were evaluated for their heat regulating power by utilizing the basic laws of regulation to derive a family of hyperbolas for the boundary conditions of regulatory systems. Relationships were derived for louver-type regulators, cylindrical regulator screening off exterior portions of reflected flux, and cylindrical regulator screening off interior portions of reflected flux. G.G.

N66-19948 Joint Publications Research Service, Washington, D. C.
DETERMINING OPTIMUM DIMENSIONS OF HIGH-TEMPERATURE CYLINDRICAL SOLAR-ENERGY CAVITY RECEIVERS
I. M. Rubanovich *In its* Heliotechnology 28 Feb. 1966 p 7-18 refs (See N66-19946 10-03) CFSTI: $3.00

Energy distribution in the focal plane of parabolic mirrors was analyzed by utilizing the energy-flux density-distribution theory to account for macroscopic deviations from ideal mirror geometry and to improve receiver efficiency. Evaluation of the pertinent energy-balance equations indicated that a 40% improved collector accuracy increases receiver efficiency approximately 12%. The same calculations disclosed the dependance of receiver efficiency on the emissive power of the cavity surface; improved emissive power of the cavity surface from 0.2 to 0.55 steps up receiver capacity from 60% to 70%. G.G.

N66-19949 Joint Publications Research Service, Washington, D. C.
MANUFACTURING FEASIBILITY OF LONG-FOCUS VACUUM FILM COLLECTOR
G. Ya. Umarov, D. Alavutdinov, and A. K. Alimov *In its* Heliotechnology 28 Feb. 1966 p 19-22 refs (See N66-19946 10-03) CFSTI: $3.00

The feasibility of manufacturing a large reflecting film surface vacuum collector was evaluated by considering the collector surface as spherical and computing the collector sagitta by a geometric method. Film tension was determined by measurements of focal spot diameter and absolute black body temperature in the center of the focal spot. It was developed that manufacturing processes for large collectors require the tightening of the metallized film against an optically accurate frame. Long-focus collectors with adjustable focal length from 1.5 to 10 m regulate black body temperature in the focal spot from 1200 to 300°C. At a focal length of more than 10 m, wind stresses have a negative effect on the optical characteristics of the collector. G.G.

N66-19951 Joint Publications Research Service, Washington, D. C.
DETERMINING AERODYNAMIC COEFFICIENTS OF SOLAR DISTILLATION UNITS TO COMPUTE VAPOR-AIR MIXTURE LEAKAGE
P. A. Dzhubaliyeva *In its* Heliotechnology 28 Feb. 1966 p 27-32 refs (See N66-19946 10-03) CFSTI: $3.00

Greenhouse-type solar distillers were tested in an aerodynamic wind tunnel for their glass-to-structure seam resistance to air blasts. The worst case of distiller operation with leaky horizontal seams was for a 0° or 120° wind direction angle with the distiller axis. At wind direction angle 0°, the difference between average values of aerodynamic coefficients at horizontal seams reached a maximum of about 0.84. G.G.

N66-19952 Joint Publications Research Service, Washington, D. C.
THE EFFECT OF SOLAR DISTILLER CHAMBER NON-AIRTIGHTNESS ON DISTILLER TECHNICAL CHARACTERISTICS UNDER HEAT PRESSURE
P. A. Dzhubaliyeva *In its* Heliotechnology 28 Feb. 1966 p 33-37 refs (See N66-19946 10-03) CFSTI: $3.00

Heat losses from leakage of a vapor-air mixture through breaks in the chamber seal of a greenhouse-type distiller

were analyzed under conditions of natural pressure and zero wind velocity. Formulas for specific heat losses, productivity, and efficiency in the case of leaks distributed along the upper and lower juncture as well as for lateral seam leakage were used to determine the distiller characteristics for leakage in upper and lower horizontal junctions. Graphical dependence curves for distiller efficiency and solar radiation strength when leaks are present are shown. G.G.

N66-19954 Joint Publications Research Service, Washington, D. C.
A SOLAR FURNACE OF POLYETHYLENETEREPHTHALATE FILM
G. Ya. Umarov and N. V. Kordub *In its* Heliotechnology 28 Feb. 1966 p 44–45 refs (See N66-19946 10-03) CFSTI: $3.00

Described is a high temperature solar furnace made by stretching a roll of metallized polyethyleneterephthalate film back and forth over a dome-shaped aluminum frame. The film was hermetically sealed to the open face of the aluminum basin. Different pressure on the film gave mirrors of various focal lengths for concentrating the sun's rays. A 92 cm mirror surface had a focal length of 120 cm and reached temperatures of 950° to 1000°C. G.G.

N66-20056# Central Lab., TNO, Delft (Netherlands).
RESEARCH ON THE FUNCTION OF THE AIR VENT IN THE POSITIVE ELECTRODE OF DRY BATTERIES [ONDERZOEK NAAR DE FUNCTIE VAN HET ONTLUCHTINGSGAATJE IN DE POSITIEVE ELECTRODE VAN DROGE BATTERIJEN]
R. H. W. Sieh 15 Nov. 1965 20 p In DUTCH
(CL-65/125; TDCK-44047) CFSTI: HC $1.00/MF $0.50

Research was undertaken to determine if gases which escape from the air vent of the old-fashioned construction of the positive electrode Leclanche elements result in damaging oxidation processes. Tests were conducted using a specially designed enclosure to measure the gases which escape from the batteries. Results indicate that the amount of gases measured was minute. Thus it appears that the air vent is not needed since the small amount of gas which does develop can escape in other ways if the battery has been properly assembled. It is pointed out that more research is needed to determine the gas discharge of batteries, less than 4 weeks old, since most gases develop during the early period; and to determine why the carbon rises at 45°, since this might cause electrolytic leakage. Transl. by J.O.

N66-20079*# Yardney Electric Corp., New York
DESIGN OF SEALED SECONDARY SILVER ZINC BATTERY Addendum to Final Report
Jan. 1966 30 p Prepared for JPL *Its* Rept.-637-66
(Contracts NAS7-100; JPL-950959)
(NASA-CR-70936) CFSTI: HC $2.00/MF $0.50 CSCL 10C

An addendum to the final design report for sealed secondary silver–zinc batteries is presented that contains additional information on test cell design and performance data. Of the three batteries tested, two developed fissures in the potting during the 140°F portion of the test run and were stopped. The third battery underwent a 15 day overcharge run at 0.020 amperes successfully. Specific data and performance values are shown in tables. G.G.

N66-20080*# Litton Systems, Inc., St. Paul, Minn. Applied Science Div.
DESIGN AND DEVELOPMENT OF AN AIR-EJECTOR POWERED PNEUMATIC SURFACE SAMPLING SYSTEM
L. W. Rees and M. J. Grundtner Dec. 1965 97 p refs Prepared for JPL *Its* Rept.-2930
(Contracts NAS7-100; JPL-950771) CFSTI: HC $3.00/MF $0.75 CSCL 13G

A pneumatic surface sampling system for use under simulated Martian environmental conditions was designed, fabricated and tested. The unit relies upon the phenomena of air blast dislodgment of surface particles by an external, traversing sampler head, pneumatic transport of particulate material to the main sampler body, and subsequent centrifugal separation by a cyclone collector. It is capable of operation with particles as large as 800 microns diameter at ambient pressures as low as 5 millibars and at ambient temperatures down to −60°C. In tests with sandy soils the collection rate of this device is on the order of 15 grams per minute for periods up to 10 minutes. Biological assessment has shown the acquired samples are representative of the environment. Author

N66-20081*# Electro-Optical Systems, Inc., Pasadena, Calif.
HIGH-PERFORMANCE THERMIONIC CONVERTER Quarterly Progress Report, 13 Aug.–13 Nov. 1965
A. E. Campbell and D. H. Pollock 23 Dec. 1965 66 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951225)
(NASA-CR-70938; EOS-6952-Q-2) CFSTI: HC $3.00/MF $0.75 CSCL 10A

A variable-parameter test vehicle was fabricated, loaded with cesium, and used to gather performance optimization data. Test vehicle operations demonstrated temperature measurements of 30°C for normal loads on the drive mechanism. Outgassing of rhenium and tantalum emitters resulted in minimal emitting surface grain growth after 100 hours operation at 2000° K. A molybdenum collector–copper radiator assembly was fabricated and tested; its braze-joint geometry retained its mechanical strength and integral bonding over 300 thermal shock cycles while transferring 200 to 225 watts, showed good heat rejection ability, and its copper radiating fin was not affected by thermal test cycling at 600°C. The active Ni-Zr alloy brazing of alumina to niobium remained leak tight through thermal shock cycles at the heating rate of 100°C/min. The seals also remained leak tight at 700°C cycling for 500 hours. A design analysis for the converter SN-101 has been completed. G.G.

N66-20082*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN–OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS Quarterly Report, 1 Oct.–31 Dec. 1965
M. Klein and E. Findl 1 Feb. 1966 43 p refs
(Contract NAS3-2781)
(NASA-CR-70939; EOS-4110-QL-6) CFSTI: HC $2.00/MF $0.50 CSCL 10A

During this period, primary emphasis was placed on the testing of single cells with various electrode structures in order to improve cycle-life capabilities and to obtain a better understanding of the mode of deterioration of cell performance. A new type of fuel cell electrode was developed, consisting of a porous-sintered, carbonyl-nickel plaque that is gold coated prior to platinization. It shows promise of improving cycle-life capabilities. From the results of single-cell tests, it has become apparent that a mode of deteriorating performance caused by impurities or contaminants in the electrolyte and/or asbestos exists. Chemical analysis of asbestos and analysis

of causes of discoloration have been initiated. A new, instrumented test setup has been partially completed that will be capable of testing two 6-cell units and 5 single-cell units simultaneously. Included in the instrument package is a digital recording system, a continuous (time-voltage) data system and a continuous manual readout system. Author

N66-20092# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL STUDY OF A MODEL CONTROL BLEEDER STAGE WITH A ROTATING DIAPHRAGM
M. Ye. Deych and A. G. Sheynkman 26 Oct. 1965 15 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 2, 1965 p 14–17
(FTD-TT-65-669/1+2+4; AD-625194) CFSTI: HC $1.00/MF $0.50

The results of study of a model control bleeder stage with rotating diaphragm are presented, the efficiency of the stage is compared to a stage with a throttle valve, and also formulas are given for the determination of response. Author (TAB)

N66-20128*# Boeing Co., Seattle, Wash.
DEVELOPMENT AND TESTING OF A LOW-TEMPERATURE HYDRAULIC SYSTEM Presentation Brochure
[1965] 107 p refs
(Contract NAS8-11722)
(NASA-CR-71025; D2-84076-1) CFSTI: HC $4.00/MF $0.75 CSCL 13G

Eighty candidate space actuation tasks are considered from which 10 are selected as having the most value. From these, one task associated with each of four vehicle types is examined in detail. The evaluation considers hydraulic, pneumatic, and electromechanical actuation systems to satisfy the requirements of each task. Power and thermal conditioning provisions for each system are considered. Trade study results are in the form of a numerical rating summary showing system comparisons on the basis of weight, reliability, cost, availability, and performance margin. Development preceding fabrication of a hydraulic system for space environment operation included the evaluation of advanced fluids and seal compounds. Testing showed how reducing fluid temperature affects system operation and the minimum operating temperature for the test fluid selected. High temperature and long term thermal cycling effects on system operation are reported. Environmental effects on seals and system operation following long term hard vacuum storage of the linear actuator are reported. A thermal analysis describes the protection required for various hydraulic applications in space. R.N.A.

N66-20215# California Univ., Berkeley. Lawrence Radiation Lab.
DESCRIPTION OF THE OPERATION OF A GENERATOR OF HIGH-VOLTAGE NANOSECOND PULSES DEVELOPED AT THE TPI RESEARCH INSTITUTE
A. I. Alikhanyan 1965 4 p Transl. into ENGLISH of a Lecture (UCRL-Trans-1194) CFSTI: HC $1.00/MF $0.50

A generator is described that produces pulses having leading edges of 2 nsec, typical durations of 40 nsec, and voltages of 250 to 500 kV, depending on the matching between the coaxial line and the load. The generator is based on the principle of discharge of a noninductive accumulator on a coaxial line. NSA

N66-20441# Aktiebolaget Atomenergi, Stockholm (Sweden).
ANALYSIS OF LINEAR MHD POWER GENERATORS
E. A. Witalis Feb. 1965 38 p refs
(AE-175)

The finite-electrode-size effects on the performance of an infinitely long MHD power generation duct are calculated by means of conformal mapping. The general conformal transformation is deduced and applied in a graphic way. The analysis includes variations in the segmentation degree, the Hall parameter of the gas, and the electrode-insulator length ratio, as well as the influence of the external circuitry and loading. A general criterion for a minimum of the generator internal resistance is given. The same criterion gives the conditions for the occurrence of internal current leakage between adjacent electrodes. It is also known that the highest power output at a prescribed efficiency is always obtained when the current is made to flow between exactly opposed electrodes. Curves are presented showing the power-efficiency relations and other generator properties as depending on the segmentation degree and the Hall parameter in the cases of axial and transverse power extraction. The implications of limiting the current to flow between a finite number of identical electrodes are introduced and combined with the condition for current flow between opposed electrodes. The characteristics of generators with one or a few external loads can then be determined completely. Examples are given in a table. It is shown that the performance of such generators must not necessarily be inferior to that of segmented generators with many independent loads. However, the problems of channel end losses and off-design loading have not been taken into consideration. Author (NSA)

N66-20660# AVCO-Everett Research Lab., Everett, Mass.
PERFORMANCE OF A SELF-EXCITED MHD GENERATOR
Arne C. J. Mattsson, Edward L. Ducharme, Edward M. Govoni, Irving B. Morrow, Jr., and Thomas R. Brogan Oct. 1965 37 p refs Presented at the Intern. Conf. on Energetics, Rochester Univ., N. Y., 18–20 Aug. 1965 Submitted for Publication
(Contract AF 33(615)-1862)
(AVCO-Everett Res. Rept.-238; AD-627037) CFSTI: HC $2.00/MF $0.50

A rocket-driven self-excited MHD generator designed for a net power output of 20,000 kilowatts was successfully operated. The generator was designed to demonstrate the feasibility of using an MHD device to provide power for limited duration at very high levels with relatively simple equipment. The paper is a general description of the generator and the experimental results of a testing program performed to study the characteristics of self-excitation and the combined operation of self-excitation and power output. TAB

N66-20898# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF GULTON INDUSTRIES, INC. 1.25 AMPERE-HOUR NICKEL CADMIUM CELLS WITH HIGH OVERCHARGE CAPABILITIES
28 Feb. 1966 16 p
(Contract W-11252-B)
(NASA-CR-71296; QE/C-66-120) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Twenty-four 1.25 ampere-hour sealed nickel-cadmium secondary spacecraft cells with high overcharge capabilities were tested for their performance characteristics and limitations. All tests were performed at ambient temperatures. Observed were: Phenolphthalein leakage, capacity, cell

shorts, immersion sealing, overcharge performance, and internal resistance at constant currents of ±5 percent. It was concluded that the capacity of the tested cells was in the acceptable range of 1.33 to 1.80 ampere-hours. The ceramic seals of the 24 cells tested did not show any leakage. G.G.

N66-21001*# Monsanto Research Corp., Everett, Mass. Boston Lab.

STUDY OF FUEL CELLS USING STORABLE ROCKET PROPELLANTS Final Report, 28 Jan. 1964-29 Jan. 1965

J. C. Orth, L. F. Athearn, R. E. Chute, R. F. Drake, R. Havlin et al 9 Mar. 1965 351 p refs

(Contract NAS3-4175)

(NASA-CR-54640; MRB5007F) CFSTI: HC $7.00/MF $1.75 CSCL 10A

Fuel cells are described that operate with storable rocket fuels as reactants. Electrodes were developed and demonstrated for N_2H_4 and H_2 fuels and HNO_3, N_2O_4, O_2 and ClF_3 oxidizers. A full cell of the type $N_2H_4/KOH/O_2$ was operated for over 2285 hours at 25°C, 100 ma/cm^2, with a voltage of 0.6–0.7 v. Oxygen pressure was one atmosphere absolute. Another full cell of the type $N_2H_4/H_3PO_4/N_2O_4$ was operated for over 645 hours at 60°C, 100 ma/cm^2, with a voltage of 0.65–0.75 v. System designs for 1-kW units using these cells were developed. Both units were 1.3 ft^3 in volume, the alkaline-O_2 unit had an indicated weight of 45 lb; the acid-N_2O_4 system weight was 67 lb. Ion exchange membrane cells were investigated. A N_2H_4/ion exchange membrane/HNO_3 cell with both reactants dissolved in H_3PO_4 was operated for 30 hours at 60°C and 100 ma/cm^2 with a voltage of approximately 0.5 v. The feasibility of steam reforming unsymmetrical dimethyl hydrazine and monomethyl hydrazine to a H_2-rich (43 mole-%) feed stream for a fuel cell was demonstrated. Author

N66-21008*# Midwest Research Inst., Kansas City, Mo. Chemistry Div.

PURIFICATION OF FUEL CELL GASES Final Report, 21 Jul. 1965-28 Feb. 1966

T. D. Bath and A. D. Mc Elroy 23 Feb. 1966 43 p refs

(Contract NAS9-5080)

(NASA-CR-65284) CFSTI: HC $2.00/MF $0.50 CSCL 10A

Means of effecting purification in-flight of hydrogen and oxygen gases delivered to the Apollo fuel cell were evaluated and screened for suitability. The techniques which appeared to be workable were further studied. Purifications which were judged to be feasible are removal of carbon dioxide and carbon monoxide from oxygen, and separation of hydrogen from impurities by diffusion through metallic membranes. No technique was found to be capable of dealing with inert impurities in oxygen. The basic units required for removing CO_2, CO, and methane from oxygen are a lithium hydroxide absorber for CO_2, a humidifier, and a catalytic burner (for combustion of CO to CO_2 and of CH_4 to CO_2 and H_2O. Carbon dioxide in very dry air or oxygen is not effectively absorbed by lithium hydroxide, and a humidifier is thus required. The three units are lined up in the order: burner, humidifier, and absorber. For the Apollo mission the combined weights of the units is estimated at about 45 lb. Parasitic power consumption is estimated to be 10KWH or 1.7% of design power output. Other possible packages are also discussed. L.S.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-19789# Royal Aircraft Establishment, Farnborough (England).

THE PROBLEM OF THE MAGNITUDE OF THE REST POTENTIAL IN AMOEBA PROTEUS [K VOPROSU O VELICHINE POTENTSIALA POKOYA U AMOEBA PROTEUS]

V. Batueva Sep. 1965 17 p refs Transl. into ENGLISH from Tsitologiya (Leningrad), V. 6, 1964 p 209-212

(RAE-LIB-TRANS-1129) CFSTI: HC $1.00/MF $0.50

The measurement of the RP in amoeba proteus has been performed by introducing electrodes to varying depths into the pseudopod, centre part of the body and the "tail" of the body during its movement. In conformity with the data in the literature large variations in the RP magnitudes (between −5 and −50 mV) have been found. On the basis of the material obtained it is impossible to agree with the earlier assumptions that the variability of the RP magnitudes in amoebae are the result of random errors of measurement, since according to our data there are two sets of RP measurements: "low" RP (between −5 and −20 mV), recorded when the micro-electrode was introduced into the region of the "tail" and into the central part of the body to a depth of 5-10 microns, and "high" RP values (between −35 and −50 mV), recorded when the electrode was inserted into the central part of the body to a depth of more than 10 microns. Additional data are required in order to solve the problem whether there really exist two RP values in amoeba proteus or whether the true magnitude should be considered solely the "high" RP values. Author

N66-19790 Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

THE POSSIBILITY OF A TWO DIMENSIONAL INFORMATION-BEARING MATRIX IN LIVING SYSTEMS [POSSIBILITA DI UNA MATRICE D'INFORMAZIONE BIDIMENSIONALE NEI SISTEMI VIVENTI]

M. Ageno 15 Nov. 1965 28 p refs

(ISS-65/43) CFSTI: HC $2.00/MF $0.50

The evidence for the existence in living systems of an important pool of hereditary information which is not stored in the DNA is discussed. This information does not seem to be related to protein synthesis, but to the physical organization of the cell, to cell differentiation and to the fundamental morphological traits of the organism. Information-bearing matrices are then examined in details, and it is shown that a linear (unidimensional) matrix, which is to be read by pieces, cannot contain topographic information. The impossibility that the source of topographic information be a fixed time sequence of events in the cell is also shown. On this ground, a new hypothesis is proposed, according to which information should be contained in some cytoplasmic membranes, the surface of which is covered by a pattern of globular protein molecules. Author

N66-19828 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.

A PROPOSED SATELLITE FOR TV OBSERVATION OF ZERO-G EFFECTS ON DEVELOPMENT OF THE OPOSSUM FETUS

S. H. Fairweather and J. E. Mortimer *In its* Space Electron. [1965] p 2-7 refs (See N66-19827 10-31)

The biological effects on mammalian tissue resulting from extended periods of weightlessness is of great interest to those concerned with life-support equipment and systems for space travel. This paper describes an experiment in which opossum embryos are orbited in a spacecraft and observed during development with TV-camera system. (The opossum is uniquely suited because of rapid maturation and the large amount of clinical data available on them.) This experiment is designed to establish benchmarks for measuring the effects of weightlessness on human tissue. Author

N66-19829 Radio Corp. of America, Princeton, N. J. Radiation Physics Group.

LIFE BEYOND THE ATMOSPHERE—ORIGINS, DETECTION, AND SUPPORT

A. G. Holmes-Siedle *In its* Space Electron. [1965] p 7-13 refs (See N66-19827 10-31)

This paper discusses the existence and detection of life forms in the universe (with emphasis on our planetary system), and the support of life in manned space travel. It is shown that while we have several good ideas as to the origin of life, much sophisticated research awaits before we arrive even at a good set of hypotheses of how life occurred. Likewise, while we can detect many forms of life chemically, much more sophisticated sensors are needed for space missions to help decide whether a certain observed phenomenon may constitute "life." Finally, although we have demonstrated short-term life-support outside the atmosphere, the present crude automatic control of a few gases and fluids will have to be refined greatly before we can, for example, establish a colony on the Moon. The advanced electronics for each of these pursuits offers engineers one of the greatest practical challenges of an already challenging technology. Author

N66-19846# Cekmece Nuclear Research Center, Istanbul (Turkey).

THE EFFECT OF TRITIATED THYMIDINE AND GAMMA IRRADIATION ON THE MORTALITY OF ADULT *DROSOPHILA MELANOGASTER* LARVAE II

Esin Kent Bolukbasi Nov. 1965 20 p refs
(CNAEM-32) CFSTI: HC $1.00/MF $0.50

Several factors that might affect the increase in mortality rate of adult Drosophila melanogaster larvae when exposed to ionizing radiations have been studied. The application of H^3TDR (tritiated thymidine) and gamma (CO^{60}) irradiation at different times to the same larvae caused a high but an additive mortality effect. The application of both irradiating agents to the larvae simultaneously caused a higher mortality rate which was even more than an additive one. Irradiated H^3TDR containing nutrient was found to be harmful for the larvae and seemed to be responsible for the increase in death amount when both factors were applied to the larvae simultaneously. Author

N66-19864# United Kingdom Atomic Energy Authority, Windscale (England). Health Physics and Safety Dept.

THE EFFECT OF SODIUM ALGINATE IN INHIBITING UPTAKE OF RADIOSTRONTIUM FROM THE HUMAN GASTROINTESTINAL TRACT

R. Hesp and B. Ramsbottom 1965 20 p refs Presented at the 1st Intern. Conf. on Med. Phys., Harrogate, England, Sep. 1965
(PG-686(W)) HMSO: 2s 6d

An experiment performed with the cooperation of a normal healthy adult male volunteer has shown that sodium alginate reduced uptake of radiostrontium from the gastrointestinal tract by a factor of about 9. In the first stage of the experiment, 0.36 μc Sr^{85} was administered orally 20 minutes after an oral administration of 10 g sodium alginate. Twenty-six days later 0.48 μc Sr^{85} was administered orally. In both stages of the experiment samples of excreta and blood were collected, and body retention of Sr^{85} was measured by means of the Windscale Whole Body Counter. The degrees of inhibition of uptake of radiostrontium affected by sodium alginate, as assessed from urine, blood plasma and body retention respectively were approximately 9.2, 9.1, and 8.8. Author

N66-19909# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aerospace Medical Div.

MOBILITY OF PRESSURE-SUITED SUBJECTS UNDER WEIGHTLESS AND LUNAR GRAVITY CONDITIONS Final Report, Jun. 1961-Jun. 1962

John C. Simons, Dieter E. Walk, and Charles W. Sears Aug. 1965 96 p refs
(AMRL-TR-65-65; AD-626979) CFSTI: HC $1.00/MF $0.50

Problems of moving through hatchways under zero and lunar gravity conditions, and related design problems of hatch size and shape, were investigated in flight. Subjects were timed and photographed as they accomplished various motions during weightless and lunar-gravity maneuvers of a large cabin aircraft. Performance data are presented for various combinations of clothing, gravity and body-position conditions. Time and contact data are presented for the egress motion as it is influenced by changes in the exit area. Orientation problems and maneuvering techniques, as influenced by area and volume restrictions, are discussed. Motions of pressure-suited subjects generally required 30% more time than corresponding motions of unsuited subjects. Most motions required 35% more time during zero G than during lunar G. No significant differences in egress times were found among four body-positions. Compared with 1 inch of exit clearance, 5 inches of clearance improved egress time by approximately 6%. Accuracy, rather than time of motion, appeared to be a more sensitive measure of operator performance for the egress task. A 95th percentile shoulder plane with a 19.4-inch major axis is proposed as a basic egress reference.

Author (TAB)

N66-19944# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.

AN ESTIMATE OF THE PREFERRED SKIN TEMPERATURE DISTRIBUTION IN MAN

D. Mc K. Kerslake London, Flying Personnel Res. Comm., Oct. 1964 9 p refs
(FPRC/MEMO-213) CFSTI: HC $1.00/MF $0.50

Skin temperature and heat loss for various body regions of humans, seated and engaged in light activity at 33°C, were studied. Tables are given with regional data for the head, trunk, hands, forearms, arms, feet, calves, and thighs. Results of the findings are discussed, with reference to the effects of normal indoor clothing. N.E.N.

N66-20017# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut fuer Flugmedizin.

CHANGE IN THE UNSPECIFIC REACTION OF THE ORGANISM DURING ADAPTATION TO HEAT [DIE ANDERUNG DER UNSPEZIFISCHEN REAKTION DES ORGANISMUS UNTER HITZEANPASSUNG]

D. Schwarz (Ph.D. Thesis—Bonn Univ.) Nov. 1965 78 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-53; DVL-441) CFSTI: HC $3.00/MF $0.75

Under extreme surrounding conditions such as occur in aviation or mining, man is subject to different kinds of stress Adaptation to each individual type of stress involved is often not possible or, at least, very difficult. The study attempts to prove that adaptation to one special type of stress (heat) will increase resistance to other types of stress (hypoxia, work, cold). Author

N66-20043# Academy of Sciences (USSR), Moscow.
RESULTS OF BIOLOGICAL EXPERIMENTS CARRIED OUT UNDER CONDITIONS OF FLIGHT IN SHIPS VOSTOK WITH PARTICIPATION OF COSMONAUTS A. G. NIKOLAYEV, P. R. POPVICH, AND V. F. BYKOVSKY
V. V. Antipov, N. L. Delone, G. P. Parfyonov, and V. G. Vystoky [1965] 15 p refs Presented at the COSPAR Symp., Florence, May, 1964 CFSTI: HC $1.00/MF $0.50

Reproduction processes in Drosophila melanogaster and the hereditary structures of Tradescantia paludosa were studied under conditions of cosmic radiation and weightlessness. The following results are reported, along with descriptions of experimental procedures and conditions. The speed of laying eggs, and the viability of embryos and larvae were shown to be approximately the same under weightlessness and normal conditions. Several explanations are given for an excess of female issue; it is suggested that the most valid of these is a relative increase in the competitive capability of the female larvae under the experimental conditions. The following apparently nonhereditary anomalies were observed in the offspring: (1) an absence of 1/2 the thorax; (2) a one-sided absence of macrochetes; (3) a decrease and roughening of one eye; and (4) a shortening and incorrect nervation of one wing. It is noted that only 1/2 of the body is affected in each case. Cytological analysis of Tradescantia microspores revealed rearrangements of chromosomes, and violations of the mitosis mechanism and growth processes. It is hypothesized that the chromosome rearrangements are caused by dynamic factors appearing at the ascent and descent of the ship. D.T.

N66-20057# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
TIME OF DUPLICATION OF SPLENIC CELLS OF MICE DURING THE LATENT AND LOGARITHMIC PHASES OF THE PRINCIPAL RESPONSE OF AN ANTIBODY [TIEMPO DE DUPLICACION DE CELULAS ESPLENICAS DE RATON DURANTE LAS FASES LATENTE Y LOGARITHMICA DE LA RESPUESTA PRIMARIA DE ANTICUERPO]
Elmo E. Capalbo and T. Makinodan (Oak Ridge Natl. Lab.) 1965 19 p In SPANISH *Its* Informe No. 15
CFSTI: HC $1.00/MF $0.50

Cellular development was studied during the latent and logarithmic phases of the primary antibody response by means of a spleen cell culture in diffusion chambers with a porosity of 0.1 microns. Results show that the reduction in growth rate of all cells and the increase in the number of mitotic cells after the antigen stimulation are principally reflections of proliferative activities of blastic and plasmatic cells. Estimates of the relation of DNA synthesis to generation time indicate that after the antigen stimulation, a significant increase between immature plasmatic and lymphatic cells was detected. This indicates that the period of DNA synthesis is prolonged or that the generation time is decreased. These results indicate that there are at least three variables to consider in intermediate cellular division from a differentiation process in an immune response, or from the variable cellular cycle depending on the stimulus and the incoming and outgoing rate. It can be concluded that the terminal plasmatic cells are the final state of differentiation from reticular-blastic cells, suggesting that if other somatic cells can give origin to terminal plasmatic cells, they should be able to assist in primary cellular division. Transl. by R.N.A.

N66-20131*# California Univ., Berkeley. Space Sciences Lab.
BIOCHEMICAL ACTIVITIES OF TERRESTRIAL MICROORGANISMS IN SIMULATED PLANETARY ENVIRONMENTS Final Report
[1964] 14 p refs
(Grant NsG-126-61)
(NASA-CR-71195) CFSTI: HC $1.00/MF $0.50 CSCL 06C

The major effort of this research program was directed toward environmental conditions that might serve as constraints upon the evolution or development of microorganisms on the surface of anaerobic planets such as Mars. Studies on low temperature freezing and thawing of microorganisms, on alternatives for atmospheric oxygen, and on ultraviolet radiation as an environmental constraint are discussed. R.N.A.

N66-20163# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF IONIZING RADIATION ON THE HEART. REACTION OF THE HEART IN NORMAL CONDITIONS TO RADIATION
S. G. Antonyan 20 Dec. 1965 22 p refs Transl. into ENGLISH from Izv. Akad Nauk Arm. SSR, Biol. Nauki (Erevan), v. 17, no. 7, 1964 p 45–54
(FTD-TT-65-1082/1+4; AD-627069) CFSTI: HC $1.00/MF $0.50

Research dealing with the morphological and functional effects of ionizing radiation on the heart is reviewed. Although many reports indicate a low sensitivity of cardiac muscle, many other reports relate considerable morphological, biochemical, and functional displacements in the myocardium in response to the action of ionizing radiation. Opinions about the degree of sensitivity of the myocardium to various doses of radiation are contradictory. The results of electrocardiographic studies after radiation doses are given. The functional changes are of a very complex nature and include displacements in the nervous and endrocrine regulation of the heart. Heart changes after irradiation during physical activity, and the effects of hypoxia and drugs are discussed. E.A.O.

N66-20165# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
LABELING INSULIN WITH I^{131} AND ITS USE IN "IN-VIVO E IN-VITRO" METHODS [MARCACION DE INSULINA CON I-131 Y SU USO EN TECNICA "IN-VIVO E IN-VITRO"]
Aldo E. A. Mitta and Hernan Juarez Penalva 1965 13 p refs In SPANISH
(CNEA-185) CFSTI: HC $1.00/MF $0.50

This paper briefly describes a technique for labelling insulin with iodine-131 and at the same time presents the results obtained with its use in an in vivo study of hepatic turnover in diabetic and non-diabetic patients; and in an in vitro study to determine the capacity of serum globulin to combine with insulin-iodine-131. The techniques and controls used and a discussion of the results, which are presented in graphical form, are included. R.N.A.

N66-20187# Academy of Sciences (USSR), Moscow.
A FEW PROBLEMS OF PHYSIOLOGY OF CIRCULATION DURING WEIGHTLESSNESS
R. M. Bayevsky and O. G. Gazenko [1963] 32 p refs
CFSTI: HC $2.00/MF $0.50

Data obtained on the circulatory system during weightlessness are presented. Biomedical investigations were carried out in satellites and in Vostok spaceships, employing electrocardiography, phonocardiography, seismocardiography, kinetocardiography, sphygmography, and arterial oscillography. The experimental data from dogs and cosmonauts are discussed and summarized in tabular form. Special attention was given to the pulse rate and the phasic nature of cardiac response to weightlessness. Three phases were distinguished: the transition phase involving after-effects of acceleration, the incomplete adaptation which lasts for 10 to 12 hours, and the relatively stable adaptation. Particular mention was made of the auriculo-ventricular conduction time, intraventricular conduction, electric and mechanical systole durations, electromechanical delay, contractile ability of myocardium, and cardiac contraction coordination. N.E.N.

N66-20201# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).
CHARGE TRANSFER: A FACTOR OF RADIORESISTANCE
H. Altmann 1965 13 p refs Presented at the IAEA Conf. "Panel on Coord. of Res. in Radiation Sensitization of Microorganisms in Food-Preservation," Wien, Austria, 5 Jul. 1965 Submitted for Publication
(SGAE-BL-16/1965) CFSTI: HC $1.00/MF $0.50

The contribution of charge and energy migration to inactivation processes by irradiation was studied. The removal of trace elements from nucleic acids of yeast was determined between 0 and 24,000 rads of Co^{60} irradiation, but diffusion of trace elements through the cell walls owing to changes on permeability was observed. Metal ions liberated from nucleic acids caused a diminution of the biological activity of the macromolecules and some slight damage to the cell by operating as inhibitors or stimulators of enzyme systems; however, the main chain of nucleic acids remained protected. It was concluded that the conductivity of nucleic acids arises by the metal ion which acts as sink for elements that are split off. Introduction of bromodeoxyuridine (BdU) into Chlorella DNA and subsequent irradiation with 5,000, 10,000, and 20,000 rad in phosphate buffer suggested a charge transfer in DNA to BdU, with Br partly split off. G.G.

N66-20206# Oak Ridge National Lab., Tenn.
THE JOINT NATIONAL INSTITUTES OF HEALTH-ATOMIC ENERGY COMMISSION ZONAL CENTRIFUGE DEVELOPMENT PROGRAM Semiannual Report, Jan. 1–Jun. 30, 1964
W. D. Fisher, et al Mar. 1965 66 p refs
(Contract W-7405-ENG-26)
(ORNL-3752) CFSTI: HC $3.00/MF $0.75

Work done under the Zonal Centrifuge Development Program on the application to difficult biophysical separation problems of techniques and instruments developed by the AEC is described. Work on zonal centrifuge systems designed to separate particles ranging in size from whole cells to small molecules has progressed with the development of several new rotor systems. The B-IV rotor has been shown to effectively separate quantities of macroglobulin from rat and other animal sera, thereby extending the usefulness of this instrument down to 20S. By application of the two-dimensional S-ρ separation system previously described, a clear spectrum of rat liver glycogen particles has been obtained, and the molecular structure revealed by negative staining is under investigation. Virus-like particles have been recovered from a human breast tumor with the same technique. Further studies on centrifugal fast freezing show that a high percentage of yeast cells survive freezing, but that the lethal damage is done during warming, which must be done rapidly if a high survival rate is to be obtained. Theoretical studies on the particle capacity of gradients in zonal centrifuges are being carried to the point that experimental studies may be designed to examine anomalous sedimentation behavior and band spreading. The low-speed A-IX rotor has been redesigned and strengthened and is now designated A-XII. Scanning systems that would make this rotor an analytical centrifuge have been completed. Continuous-flow rotors in which the sediment particles are banded in a gradient during the continuous-flow process (rotor B-VIII) have been built and successfully tested. A completely enclosed virus separation facility has been designed for large-scale virus separation. In addition to centrifuges, new countercurrent systems for liquid–liquid extractions and the flame ionization detector for nonvolatile samples are under development. A prototype automated system for carbohydrate analysis has been completed and tested with a variety of sugar-containing samples. With an experimental high-pressure capillary column nucleotide analyzer, it has been demonstrated that rapid analysis of very small samples can be performed with micro ion exchange beads, warm columns, a high flow rate, and columns of very small bore. Author (NSA)

N66-20218# Rochester Univ., N. Y.
MITOCHONDRIA AND RADIATION SENSITIVITY OF CELLS
E. Tsinga and G. W. Casarett 19 Jul. 1965 76 p refs
(Contract W-7401-ENG-49)
(UR-666) CFSTI: HC $3.00/MF $0.75

Albino male rats were exposed to 800 R total-body X-irradiation and sacrificed thereafter at various time intervals up to 40 days. Samples of pancreas, intestine, thymus, liver, kidney, adrenal, and testis were prepared for histopathological and mitochondrial study by means of the optical-microscope. Globulation, clumping and disappearance of the mitochondria were observed in the degenerating radiosensitive cells of the intestine, thymus, and testis after irradiation. No changes in the morphology, number, or distribution of the mitochondria were detected in the radioresistant parenchymal cells of the pancreas, liver, kidney, and adrenal, or other radioresistant cells in any of the organs studied. It was concluded that mitochondrial morphology was relatively resistant to the actions of X-rays and that the effects observed were not specific for irradiation but secondary to other injuries in cells. The mitochondrial content in the different kinds of cells was suggested as an important factor in the relative degree of the sensitivity of resistance of the cells to the cytocidal effects of irradiation, with radiosensitive cells generally containing a smaller mitochondrial content than radioresistant cells. Author (NSA)

N66-20219# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
CONDITIONING OF PRIMATES FOR EXPERIMENTATION [CONDITIONNEMENT DES PRIMATES POUR L'EXPERIMENTATION]
Bernard Legeay, Michel Geneste, and Guy Brawers Mar. 1965 35 p refs In FRENCH
(CEA-R-2714)

The care and feeding of monkeys for experiments is discussed. The construction of a monkey-house, the hygiene

rules necessary for obtaining subjects with relatively stable biological parameters are described. This hygiene includes prophylactic treatment, because the animals lived originally in the wild state; a balanced diet, following modern dietetic standards; and a habitat which recreates the original living conditions of the species. The rate of reproduction was used as a criterion of the efficiency of the methods applied.
Author (NSA)

N66-20225# Norsk Radiumhospital, Oslo.
INDUCED RADIOACTIVITY CAUSED BY THERAPEUTIC USE OF HIGH ENERGY RADIATION
Aksel Strömme [1965] 9 p
(Contract AT(30-1)-3364)
(NYO-3364-6) CFSTI: HC $1.00/MF $0.50

Measurements of patients in a whole-body counter after therapeutic irradiation indicated induced radioactivity of the order of 350 microcuries. The therapeutic betatron beam used contained, besides γ rays, a certain unknown neutron flux. The counting equipment used allowed the detection of only those isotopes giving rise to γ radiation in excess of 25 keV energy and with half-lives in excess of about 20 sec. The isotopes detected and identified by measurements of their half-life and energy spectrum included ^{11}C, ^{13}N, ^{15}O, ^{30}P, ^{34}Cl, ^{38}K, and iodine. These were created by $(\gamma,2n)$ or (n,γ) reactions. The amounts of isotopes created per gramatom during an 11 min irradiation, the equivalent of 200 R, were calculated. NSA

N66-20244# Nuclear Utility Services, Inc., Washington, D. C.
CALCULATIONAL MODELS FOR BETA DOSE FROM SPHERICAL PARTICLES
George H. Anno 26 Feb. 1965 83 p refs
(NUS-217) CFSTI: HC $3.00/MF $0.75

A means of calculating the beta ray dose in tissue from a mixed radionuclide source particle of arbitrary size is considered for possible inclusion in the ROVER Flight Safety evaluation or NURSE programs. For the present case, the source particle is a high-Z material ($Z \simeq 84$) and contains a mixed beta ray spectra, while dose distribution in tissue, a low-Z material ($Z \simeq 7$), is desired; a situation for which appropriate data are lacking. An investigation of the presently available techniques and data was carried out in order to (1) prescribe a method of computing the beta dose from a fuel particle for present use and also to (2) determine alternate methods to accomplish this task more accurately, perhaps by more detailed methods, if necessary in the future. A current calculational model based on experimental dose attentuation of more monoenergetic beta ray sources was developed for which the equations can readily be translated to FORTRAN. Some hand calculations have been made in order to compare results with experimental data and results obtained by other methods. These comparisons indicate good agreement with measured data for the particle surface leakage dose, and only approximate agreement for deeper penetration. Author (NSA)

N66-20280*# Oak Ridge National Lab., Tenn. Biology Div.
THE ORNL SPACE BIOLOGY PROGRAM Annual Report, Period Ending 30 Jun. 1965
G. E. Stapleton and E. B. Darden, Jr. Sep. 1965 19 p refs
(NASA Order R-77; NASA Order R-60; Contract W-7405-ENG-26)
(ORNL-TM-1217) CFSTI: HC $1.00/MF $0.50 CSCL 06R

Work performed in the AEC-NASA Space Biology Program is described. At present the general space radiobiology program supports chiefly high energy proton studies on several mammalian systems, including cataractagenesis, shortening of life span, and acute lethality. Development of the Oak Ridge Isochronous Cyclotron facility, pertinent dosimetry, and results to date are reported. Results obtained in mock-up experiments in preparation for the Biosatellite A Project are also reported. Participation in the Gemini IV experiment are not covered in this report. Author (NSA)

N66-20324# State Univ. of New York at Buffalo. Dept. of Biology.
FACTORS INFLUENCING RADIORESISTANCE OF MICROORGANISMS Technical Progress Report, 1 Jan.–15 Sep. 1965
Alan K. Bruce 24 Sep. 1965 25 p refs
(Contract AT(30-1)-3319)
(NYO-3319-7) CFSTI: HC $1.00/MF $0.50

Progress is reported on work continued on: ultraviolet modification of *Micrococcus radiodurans* by p-hydroxymercuribenzoate (HMB); X-ray does response of HMB binding in *M. radiodurans*, *S. lutea*, and *E. coli*; the effect of phase state on dose-modification by MEA and HMB in bacteria; and identification of protective compounds in *M. radiodurans*. New approaches during the report period included localization of bound HMB and extraction of DNP from *M. radiodurans*.
NSA

N66-20368# Institute for Cancer Research, Philadelphia, Pa.
STUDIES OF THE EFFECTS OF ULTRAVIOLET RADIATION ON CELL STRUCTURE AND BEHAVIOR Annual Progress Report, Jan. 1963–Nov. 1964
Jerome J. Freed 21 Jan. 1965 20 p refs
(Contract AT(30-1)-2356)
(TID-21581) CFSTI: HC $1.00/MF $0.50

A vibrating mirror flying spot microscope is described that was designed and constructed to measure ultraviolet absorbancy of single living cells in culture and to display the absorbancy of the specimen as a television image on a synchronized television display tube. The equipment gave good results in studies of structural and metabolic mechanisms involved in the control of cytoplasmic motility as observed in tissue cultures. It was found that measurements could be made at dose levels low enough to avoid damage to the cell and the normal increase in absorbancy through interphase could be recorded. Preliminary results are reported from studies on isolated rat liver nuclei; measurements of the cell growth-duplication cycle of hamster cells growing in uv-transparent medium; the effects of puromycin, a protein synthesis inhibitor, on HeLa cells grown in perfusion chambers; inclusion bodies in fixed preparations of HeLa cells; the effects of colchicine, a mitotic inhibitor, on the saltatory movement of cytoplasmic particles during interphase of HeLa cells in culture; and genetic studies on haploid and diploid embryo cells of *Rana pipiens* and *Rana sylvatica* in culture. NSA

N66-20415# Atomic Weapons Research Establishment, Aldermaston (England).
CHELATING AGENTS. PART 2: RADIOELEMENT REMOVAL AND THE STRONTIUM-90 PROBLEM
J. H. Grimes, A. J. Huggard, and K. T. B. Scott Apr. 1965 41 p refs
(AWRE-O-4/65) HMSO: 6s

The radioelements which at present constitute hazards to humans are considered with respect to their behavior in the body. Theoretical considerations for their removal from blood and from bone are presented, and suggestions are made for

the properties of a suitable chelating agent. Chelation with the alkaline earth metals is discussed and the possibilities of obtaining a strontium-preferring chelating agent are outlined. Author

N66-20466# Milan Univ. (Italy). Inst. of Pharmacology.
EFFECT OF IONIZING RADIATIONS ON THE CONTROL MECHANISMS OF LIPID TRANSPORT Annual Report No. 2, 1 Feb. 1964-31 Jan. 1965
[1965] 24 p refs
(Contract AT(30-1)-3097)
(TID-21496) CFSTI: HC $1.00/MF $0.50

Total body X-irradiation (1000R) induced a significant increase in cholesterol and triglyceride plasma levels of old rats and a much more pronounced effect on the same lipid fractions in rabbits. The three possible mechanisms responsible for this type of hyperlipemia were investigated. Increased lipid mobilization, fatty acid synthesis in the liver or triglyceride hypersecretion to the plasma could now be invoked as the responsible mechanisms. Data indicate a decreased peripheral utilization of triglycerides as the major cause of hyperlipemia. The modified lipoproteins produced in irradiated rabbits and accumulated in the plasma compartment were slowly metabolized by the RES and the resulting hyperlipemia is therefore greatly dependent on the functional activity of RES. A conventional radio-protective drug (cysteamine) was not able to counteract this particular effect of total-body irradiation. Author (NSA)

N66-20470# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
ECOLOGY OF THE NEVADA TEST SITE. I: GEOGRAPHIC AND ECOLOGIC DISTRIBUTIONS OF THE VASCULAR FLORA (ANNOTATED CHECKLIST)
Janice C. Beatley (Nev. Test Site Herbarium) Apr. 1965 67 p refs
(Contract AT(04-1)-GEN-12)
(UCLA-12-553) CFSTI: HC $3.00/MF $0.75

A checklist of vascular plants of the Nevada Test Site is presented for use in studies of plant ecology. Data on the occurrence and distribution of plant species are included. Collections were made from both undisturbed and disturbed sites. NSA

N66-20494# Princeton Univ., N. J. Dept. of Biology.
BIOCHEMISTRY OF GAMETOGENESIS AND FERTILIZATION IN ALGAE Final Report, Oct. 1962-30 Sep. 1964
Raymond F. Jones 29 Jan. 1965 10 p refs
(Contract AT(30-1)-3105)
(NYO-3105-1) CFSTI: HC $1.00/MF $0.50

The life cycle of the algae, chlamydomonas, is discussed with emphasis on the biochemistry of gametogenesis and fertilization. NSA

N66-20511# Colorado State Univ. Research Foundation, Fort Collins. Dept. of Poultry Science.
X-IRRADIATION OF THE DEVELOPING AVIAN EMBRYO AS A FACTOR OF AGING Research Report, Sep. 20, 1964-Sep. 10, 1965
Harry D. Muller 24 Sep. 1965 36 p
(Contract AT(11-1)-1119)
(COO-1119-4) CFSTI: HC $2.00/MF $0.50

Data are reported on the body weight, reproductive capacity, blood pressure, heart rate, and mortality parameters of chickens exposed to X-irradiation during embryonic development, evaluated at 42 mo. of age. Body weight evaluations demonstrated that the control animals and the survivors of low doses of irradiation demonstrate heavier body weights than the survivors of LD_{50} or greater doses of irradiation. Age at time of administration of the treatment appears to have less influence than the total dose administered. Sex apparently has no observable influence on these responses other than those normally found in the mature body weights of the domestic fowl. Reproductive capacity evaluations demonstrated that irradiation survivor females continue to demonstrate impaired ovulation rate. However, the ability of the male survivors to fertilize both irradiation survivor and control females is not measurably impaired. Matings between control individuals and survivor individuals, as well as matings between survivor individuals, have demonstrated that these individuals are capable of competing on a percentage basis with unexposed individuals in the production of viable progeny. Blood pressure evaluations demonstrated that the survivors of the higher doses of irradiation demonstrate lowered diastolic and systolic pressures when compared to the control individuals. Physiological impairment at a period of 36 months after exposure still demonstrates statistically significant deviation from control values. Heart rate measurements showed few significant differences between irradiation survivors or between irradiation survivors and unirradiated controls. Where these significant deviations were observed the heart rate of control individuals decreased to a point significantly less than that of several survivor groups. This was the first observation of this nature and will be carefully scrutinized for its behavior in the next test period. Mortality rates have yet to reach a sufficient level for accurate statistical probit analysis of effects of embryonic irradiation on life span. Only a few of the survivor groups have cumulative mortality rates which exceed the mortality rates of the control groups. It is possible that the prenatal irradiation treatments acted as a selective process, eliminating those which would have died during their juvenile life. Categorical breakdown of mortality causes still does not supply sufficient information to project the effects of embryonic irradiation upon the reproductive, somatic, or the interaction of the effects upon these two systems. Author (NSA)

N66-20512# Max-Planck-Institut für Biophysik, Frankfurt am Main (West Germany).
RADIATION EFFECTS ON LIVING TISSUES AND ORGANISMS. SERIES C: BIBLIOGRAPHIES
W. Stahlhofen, comp. Apr. 1965 248 p refs In GERMAN; ENGLISH Summary
(AED-C-04-18)

A list is presented of 820 references to recent publications on radiation effects on living tissues and organisms. Author, corporate source, and subject indexes are included. NSA

N66-20515# Brookhaven National Lab., Upton, N. Y. Biology Dept.
THE RADIOSENSITIVITY OF *MARCHANTIA* THALLI AS RELATED TO NUCLEAR AND INTERPHASE CHROMOSOME VOLUMES
Morton W. Miller and Arnold H. Sparrow [1965] 6 p refs Presented at the Symp. on Mutational Process, Prague
(Contract AT(30-2)-GEN-16)
(BNL-9611; CONF-650814-3) CFSTI: HC $1.00/MF $0.50

Studies on the comparative radiosensitivities of plants have shown that the size of the nucleus and/or the chromosomes is an important factor in determining tolerance. Results are reported from an attempt to determine the radiosensitivity of cells within multicellular structures, the gemmae and thalli of *Marchantia polymorpha* L., a thalloid liverwort.

The gemmae are asexual reproductive propagules produced by the haploid thallus within a gemmae cup. The bryophytic capacity for cellular totipotency is well known and the gemmae and thalli Marchantia have this capacity for proliferation; it appears that if an intact cell has not lost is reproductive integrity it will produce a vegetative outgrowth in the absence of other inhibitory factors. The nuclear volume of apical cells ($98.9 \pm 4.9\mu^3$) of Marchantia gemmae was much larger than the nuclear volume of other vegetative cells capable of producing a vegetative outgrowth ($54.7 \pm 3.3\mu^3$). The lethal x radiation exposures for the apical and non-apical vegetative cells of the gemmae were approximately 29 kR and 55 kR respectively. The energy absorbed by the gemminiferous apical and non-apical vegetative cells at the 100% lethal exposure is $18.3 \pm 0.9 \times 10^6$ ev and $19.2 \pm 1.6 \times 10^6$ ev per chromosome, respectively. Thus actual tolerance is not different. These amounts of energy are approximately 4.7 times greater than the reported average amount of energy absorbed per chromosome for growing herbaceous angiosperms at the 100% lethal exposure. The nuclear volumes for apical and non-apical vegetative cells of Marchantia thalli are approximately 129 μ^3 and 12 μ^3, respectively. Apical and non-apical proliferation in thalli are eliminated by exposures of 10 kR and 55 kR, respectively. The energy absorbed at the 100% lethal exposure by the most resistant cells of the thallus was 4.0×10^6 ev per chromosome, which is insignificantly different from the amount of energy absorbed by herbaceous angiosperms irradiated at the 100% lethal exposure. Author (NSA)

N66-20550# Atomic Weapons Research Establishment, Aldermaston (England).

THE HAZARDS TO THE HUMAN EAR FROM SHOCK WAVES PRODUCED BY HIGH ENERGY ELECTRICAL DISCHARGES

Pamela M. Golden and R. Clare Aug. 1965 24 p refs
(AWRE-R-1165) HMSO: 6s

Recent years have produced a proliferation of multiple condenser banks in connection with plasma physics and other research. Examples of other electrical discharges at high energy are spark gaps and exploding wire devices, all of which are liable to produce shock waves which constitute a further possible hazard. Hitherto the energy from such sources has been regarded as being of the same level as that from small arms fire, and no particular precautions, other than using conventional ear muffs, defenders or keeping at an arbitrary safey distance, have been considered necessary. The blast pressures developed by a high energy electrical discharge as received by a transducer mounted in a large baffle normal to the blast were measured and compared with those received by a model ear. It is shown that the pressures developed at the drum of the ear are in excess of those in air and can cause damage to the ear unless precautions are taken. There is a high proportion of large amplitude noise at audio frequencies present which many protective devices transmit. Measurements with samples of these show that there is some attenuation of pressure and it is probable that a muff protector is more efficient than an ear defender which consists of a solid plug with a small axial air channel. Author (NSA)

N66-20646# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

MORPHOLOGICAL DESCRIPTION OF A BACTERIOPHAGE OF EXTRAORDINARY DIMENSIONS, ACTIVE ON *B. MEGATHERIUM* [DESCRIZIONE MORFOLOGICA DI UN BATTERIOFAGO DI ECCEZIONALI DIMENSIONI, ATTIVO SU *B. MEGATHERIUM*]

C. Frontali and F. Tangucci 5 Oct. 1965 25 p refs
(ISS-65/30) CFSTI: HC $1.00/MF $0.50

A phase of unusual dimensions, active on B.megatherium is described. It has been identified in lysates of B.megatherium together with phage α, but, so far, it has not been possible to culture it separately. It has been possible to describe the contractile mechanism of the tail as a result of morphological studies done with the aid of the electron microscope. The head, octahedral in shape (a shape never before observed in other viruses) has an edge 0.14 μ long. Author

N66-20647# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

QUANTUM MECHANICS AND MOLECULAR BIOPHYSICS [MECCANICA QUANTICA E BIOFISICA MOLECOLARE]

M. Ageno 17 Dec. 1965 58 p refs *In* ITALIAN; ENGLISH Summary Presented at a Conf. held at Rome Univ., 17 Dec. 1965
(ISS-65/46) CFSTI: HC $3.00/MF $0.50

This report discusses the limits within which it could be necessary to use quantum mechanics to understand the phenomena which take place in living cells. After using two examples to show that quantum mechanics sometimes leads to conclusions different from those of classical mechanics even in macroscopic systems, we propose to examine such a theory to see if it could be used to describe biological phenomena. The calculations concerning this problem made by Wigner and Landsberg, who have reached negative conclusions, are examined critically. Having shown why such theories are not applicable in the case of living organisms, we demonstrate that quantum mechanics effectively possesses the necessary means to also describe complex biological phenomena such as cellular reproduction. Thus we can undertake with confidence the application of quantum mechanical concepts in order to explain particular cellular phenomena. Author

N66-20649# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

LABELLED TRIIODOTHYRONINE IN THE STUDY OF THE THYROID FUNCTION BY MEANS OF ITS USE *IN VITRO* [TRIYODOTIRONINA MARCADA EN EL ESTUDIO DE LA FUNCION TIROIDEA MEDIANTE SU USO *IN VITRO*]

Hector Forcher and Osvaldo Jorge Degrossi 1965 17 p refs In SPANISH
(CNEA-166) CFSTI: HC $1.00/MF $0.50

Results are presented of an *in vitro* study of the thyroid function by means of the fixation of triiodothyronine I^{131} by a resin of anionic interchange (Amberlita IRA 400) and by polyurethane sponge. With the obtained results, it was possible to differentiate between euthyroidism and hypo- and hyperthyroidism. The correlation between both methods was excellent. Transl. by R.N.A.

N66-20656# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

GLYCOGEN PARTICLES SEEN IN THE ELECTRON MICROSCOPE [GRANULI DI GLICOGENO AL MICROSCOPIO ELETTRONICO]

G. Rosati 5 Oct. 1965 24 p
(ISS-65/33) CFSTI: HC $1.00/MF $0.50

Liver and striated muscle glycogen particles were examined in the electron microscope. Enzymatic treatment was applied to them. Liver glycogen particles disappeared from the sections after treatment by all the enzymes used, whereas, the striated muscle particles remained intact. Author

N66-20678# California Univ., Berkeley. Sanitary Engineering Research Lab.

A STUDY OF FUNDAMENTAL FACTORS PERTINENT TO MICROBIOLOGICAL WASTE CONVERSION IN CONTROL OF ISOLATED ENVIRONMENTS Eighth Quarterly Report, Feb. 1964–Feb. 1965

Clarence G. Golueke, William J. Oswald, and Henry K. Gee 31 Mar. 1965 54 p refs /ts Sci. Rept.-2
(Contract AF 19(628)-2462)
(SERL-65-14; AFCRL-65-496; AD-627036) CFSTI: HC $3.00/MF $0.50

The report describes experiments with an algatron system (i.e., one that involves the use of a mechanically rotated culture) and presents a design of a system to support two men. An average algae yield of 1500 mg/1/day was obtained at inner and outer light intensities of 225 and 270 ft-c, respectively, the maximum light intensities obtainable with the available light source. From 87 to 91% of incoming volatile solids were stabilized at detention periods from 0.25 to 1 day. No relation was noted between detention period and removal of P, Mg, Ca, and N. Low temperature distilled water yield was 1.83 ml/sq m/min (ambient relative humidity, 80%). Water losses from an algal culture and from a carbon black suspension were closely similar; and that from both, about 5% greater than from water alone. Design estimates based on the experimental conditions indicate that a maximum of 11 algatrons, each 18 in. in diameter and 4 ft. long would be required per man for gas exchange, waste treatment, and water recovery (about 200 liters/day). Author (TAB)

N66-20691# United Kingdom Atomic Energy Authority, Research Group.

ACTION OF TRISODIUM MONOCALCIUM SALT OF DIETHYLENE-TRIAMINE-PENTA-ACETIC ACID (Ca D.T.P.P.A. Na_3) IN HUMAN LEAD POISONING

S. Martin, C. Boudene, R. Truhaut, and C. Albahary Sep. 1965 22 p refs Transl. into ENGLISH from Arch. Maladies Profess. Med. Trav. Securite Sociale (Masson), v. 25, no. 7-8, 1964 p 407–418
(AERE-TRANS-1042) HMSO: 2s 6d

Investigations on more than 100 subjects, resulting in 1200 estimations of urinary lead, were made to test the effectiveness of diagnosing and treating lead poisoning. The trisodium monocalcium salt of diethylene-triamine-penta-acetic acid, Ca D.T.P.A. Na_3, was used, and a comparison made with the disodium monocalcium salt of ethylene-diamine-tetra-acetic acid, Ca E.D.T.A. Na_2. Subjects tested included: (a) a control group, (b) workers with lead colic, (c) workers exposed to toxic hazards, (d) workers exposed to irregular hazards, (e) workers exposed to minor hazards, and (f) people with alimentary lead poisoning. The chelating agent was administered intravenously, by perfusion, and by the intramuscular route. It was concluded that the direct intravenous route is at present the best method of administration. The Ca D.T.P.A. Na_3 was found to bring about plumburia a little more markedly than did Ca E.D.T.A. Na_2. The same principles in use and in precautions for the trisodium salt as for the disodium salt are recommended. N.E.N.

N66-20803# Chicago Univ., Ill.

USAF RADIATION LABORATORY Quarterly Progress Report

Kenneth P. Du Bois et al 15 Oct. 1965 47 p refs
(Contract AF 41(609)-1693)
(QPR-57; AD-623599) CFSTI: HC $2.00/MF $0.50

The report concerns studies on the scope and the nature of the inhibitory affect of X-radiation on the biosynthesis of enzymes in the microsomal fraction of the liver. The results of the research summarized in the report indicate that radiation specifically inhibits the process responsible for the development of a sex difference in hepatic detoxification enzymes in rats and that this effect is mediated through some area in the central nervous system. TAB

N66-20827# California Univ., Los Angeles. School of Medicine.

1, 1-DIMETHYLHYDRAZINE EFFECTS ON CENTRAL EXCITATORY AND INHIBITORY MECHANISMS IN CATS Final Report, Jan. 1964–Jun. 1965

M. D. Fairchild and M. B. Sterman Wright-Patterson AFB, Ohio, ARML, Aug. 1965 41 p
(Contract AF 41(609)-2329)
(AMRL-TR-65-142; AD-623786) CFSTI: HC $2.00/MF $0.50

Experiments, using cats with chronically implanted brain electrodes, were performed to explore the influence of subconvulsive doses of 1, 1-dimethylhydrazine (UDMH) on certain excitatory and inhibitory mechanisms in the central nervous systems (CNS). The cats were stimulated electrically in the midbrain reticular activating system, the basal forebrain inhibitory area, and both areas simultaneously while the animal was tested for performance in a positively reinforced experimental situation. UDMH was compared with amphetamine, chlorpromazine and phenobarbital both in the presence and absence of CNS stimulation. UDMH acted in a manner similar to chlorpromazine in subconvulsive doses in these tests. The most interesting and consistent effect of UDMH was to abort performance when the basal forabrain inhibitory area was stimulated. The animals resumed performance when the stimulus was terminated. UDMH has detectable CNS effects at doses well below convulsive levels. Author (TAB)

N66-20832# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE UNIVERSE UNDER THE MICROSCOPE

A. L. Dmitriyev 3 Jan. 1966 14 p Transl. into ENGLISH from Vokrut Sveta (USSR), no. 9, 1963 p 37–39
(FTD-TT-65-1341/1+2+4; AD-627119) CFSTI: HC $1.00/MF $0.50

A narrative approach is taken to the various biological and exobiological problems associated with man's penetration of space. Several viewpoints are reviewed, the possibility of extraterrestrial life is discussed, and the findings from experimental simulations are summarized. D.T.

N66-20849# Joint Publications Research Service, Washington, D. C.

BIOLOGICAL LABORATORY IN ORBIT

N. M. Sisakyan, V. N. Pravestskiy, and B. B. Yegorov 17 Mar. 1966 16 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 2 Mar. 1966 p 3
(JPRS-34-600; T-66-31039) CFSTI: $1.00

The physiological experiments being carried out on the two dogs in the satellite Kosmos 110 in March 1966 are reported. The state of the neuro-reflex regulation of the cardiovascular system was investigated by means of implanted electrodes. The arterial pressure, heart biocurrents, the carotid artery pulse curve, and the heart's mechanical operation were measured. The cabins for the dogs are described, and also the feeding arrangements, in which the food was fed directly into the stomach by means of pneumatic devices. Radiosensitivity of

biological specimens, and the radiation doses and their distribution in the cabin were measured, and types of shielding were investigated. It was reported that data was arriving satisfactorily. N.E.N.

N66-20855# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.

STUDIES ON THE RETENTION AND METABOLISM OF INHALED METHYL IODIDE. 3: METABOLISM OF METHYL IODIDE

A. Morgan, D. J. Morgan, J. C. Evans, and B. A. J. Lister Dec. 1965 29 p refs

(AERE-R-5013)

A number of experiments are reported in which methyl iodide, labelled with iodine 132, was administered by inhalation to four volunteer subjects to study the metabolism of the retained material. The fate of iodine 132, administered in this way appears to be very similar to that of radioiodine administered orally as inorganic iodide. This indicates that in vivo, methyl iodide is broken down very rapidly and the organically bound iodine converted to the iodide ion. This conclusion is supported by a comparison of thyroid uptake and urinary excretion rates observed after administration of iodine 132 to the same subject by (a) inhalation as methyl iodide and (b) ingestion as sodium iodide. Apart from small differences, due to the longer time taken for the ingested radioiodine to be absorbed, the metabolism appeared to be identical for all practical purposes. The average radiological dose to the thyroid, in these studies with iodine 132, was less than 20 mrem per experiment. Author

N66-20879# Midwest Research Inst., Kansas City, Mo.

OBJECTIVE TESTS FOR USE IN THE TECHNOLOGY OF COMPRESSED FOODS Final Report, Jun. 1963–Jun. 1964

E. R. Morris Natick, Mass., Army Natick Labs., Sep. 1965 109 p refs

(Contract DA 19-129-AMC-130(N))

(FD-26; AD-624869) CFSTI: HC $4.00/MF $0.75

Objective methods are described for determining specific physical, chemical and microbiological properties of compressed food bars. The suitability of these methods was demonstrated by application to fresh and aged (3 months at 100°F) bars prepared from meat, fruit, cereals, vegetables, and dairy products and which represented broad concentration ranges of moisture, fat, protein, carbohydrate, and common approved chemical additives. Author (TAB)

N66-20932*# National Aeronautics and Space Administration, Washington, D. C.

SOIL MICROBIOLOGY AND ITS CURRENT PROBLEMS [POCHVENNAYA MIKROBIOLOGIYA I YEYE OCHEREDNYYE ZADACHI]

Ye. N. Mishustin Mar. 1966 30 p refs Trans. into ENGLISH from Tr. Inst. Mirkobiol., Akad. Nauk SSSR (Moscow), v. 1, no. 1, 1965 p 155-175

(NASA-TT-F-414) CFSTI: HC $0.35/MF $0.50 CSCL 02C

Problems in the afforestation of grassland and wasteland are discussed from the viewpoint of soil microbiology, including aspects of increase in grain and other harvests by optimum soil management. Symbiotic association of fungi and higher organisms is suggested for growth promotion of young tree plantings, with such soil to be provided by mycorhiza nurseries. Grassland conservation cropping and artificial humus enrichment by microbe inoculation and suppression of aerobic bacteria are discussed in their theoretical and practical aspects. The Waksman theory of humus formation in the soil by polymerization of lignin and bacterial proteins is disputed, and the theory of combination of protein matter with uronqnic acids from pectin decomposition is advanced instead. A brief review of microbiological soil testing is included, with tabulated data on microbe contents of various types of soil. Author

N66-20935*# Webb Associates, Yellow Springs, Ohio.

A SYSTEMATIC STUDY OF THE HUMAN SWEAT RESPONSE TO ACTIVITY AND ENVIRONMENT IN THE COMPENSABLE ZONE OF THERMAL STRESS Final Report

W. V. Blockley Dec. 1965 128 p refs

(Contract NAS9-3356)

(NASA-CR-65260) CFSTI: HC $4.00/MF $1.00 CSCL 06S

The interrelationships between several physiological variables involved in thermal regulation and their effect on performance reserve were examined. Environments varied from cool to oppressively warm, and three levels of activity and five temperatures for each activity level were selected. Test results are analyzed, and the data tabulated. Among the conclusions drawn from the findings are the following: (1) The sweat rate and skin temperature are linearly related. (2) The sweating threshold is highiy variable in terms of surface skin temperature, being dependent upon metabolic rate, skin thermal resistance, and skin-fold thickness. (3) Voluntary dehydration was successfully eliminated by pre-experiment fluid intake. Body weight can be maintained even with high sweat rates by starting water intake early and continuing with frequent drinks at brief intervals. (4) Environment–activity combinations equal in P4SR index are not necessarily equal in physiological strain. N.E.N.

N66-20978# Joint Publications Research Service, Washington, D. C.

EFFECT OF PROPHYLACTIC ADMINISTRATION OF A MUCOPOLYSACCHARIDE (MPS) PREPARATION ON HEMOPOIESIS AND SURVIVAL OF ANIMALS FOLLOWING X-RAY IRRADIATION

A. S. Shitikova 14 Mar. 1966 9 p refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 10, no. 12, Dec. 1965 p 44–46

(JPRS-34550; TT-66-30990) CFSTI: $1.00

Prophylactic administration of a mucopolysaccharide (MPS) preparation made from the spleen of cattle is found to have a favorable effect on the proliferation and maturation of hemopoietic organs in irradiated rabbits. The MPS administration results in less reduction of bone marrow cells on the seventh day following irradiation, and lesser changes in peripheral blood are evidenced at the height of radiation sickness. The absolute number of erythroblasts and basophilic normoblasts on the 21st day after irradiation was 216% of the initial level, whereas in the control rabbits these numbers did not reach the initial levels. In addition to studies with rabbits, survival rate of irradiated mice who received MPS injection was found to be higher than for those who received no injection. In the control group, there was a 50% mortality rate on the ninth day following irradiation, and in the MPS-group half of the mice did not expire until the 13th day. M.W.R.

N66-20981# Institut d'Embryologie Experimentale, Nogent-Sur-Marne (France).
STUDY OF RADIATION EFFECTS ON THE EMBRYO AND ITS ORGANS *IN VIVO* AND *IN VITRO*, 1 OCTOBER, 1964–30 SEPTEMBER, 1965 [ETUDE DE L'EFFET DES RAYONNEMENTS SUR L'EMBRYON ET SES ORGANES *IN VIVO* ET *IN VITRO*, 1.10.1964–30.9.1965]
Brussels, EURATOM, Jan. 1966 20 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-039-64-10 BIOF)
(EUR-2643.f) CFSTI: HC $1.00/MF $0.50

The research findings set out in this report relate to various aspects of radiobiology. They concern the action of X-rays on germ-cells, the migratory power of these cells, and DNA synthesis in gonocytes studied by means of labelling with tritiated thymidine. The action of X-rays on the physiology and respiratory metabolism of the embryo intestine and heart was investigated extensively. Certain biochemical X-ray effects on coenzyme I and its glycohydrolase were revealed. The mode of action of chemical radioprotective agents, such as cysteamine, was studied on an embryonic organ cultivated *in vitro*. Certain early radiation lesions were detected by electron microscopy. The radiosensitivity of the natural inductor in amphibians was measured, as also was the teratogenous action of radiomimetic substances such as nitrogenated mustard gas. Irradiation experiments were carried out on cancerous nodules cultivated *in vitro* and a number of regeneration problems solved with the aid of X-ray irradiations. Author

N66-21094*# Allied Research Associates, Inc., Concord, Mass.
SUMMARY REPORT ON A REVIEW OF BIOLOGICAL MECHANISMS FOR APPLICATION TO INSTRUMENT DESIGN, VOLUME III
J. Healer and M. Messer, ed. Washington, NASA, Mar. 1966 109 p refs
(Contract NASw-535)
(NASA-CR-415) CFSTI: HC $1.40/MF $0.75 CSCL 06D

This study is concerned with the investigation of the function, structure and operational principles of biosensor mechanisms throughout the animal world, the integrated role of the sensor in a total regulatory control loop, engineering analyses of sensor operation, and the evaluation of this data in terms of present and anticipated instrumentation requirements for a variety of applications. Similarities and differences between these bio-transducers and their physical counterparts were investigated with particular emphasis paid to studying those characteristics of biosensors which are not currently used in instrumentation. Instrumentation thus conceived may have application in a variety of areas ranging from hydrospace to interplanetary space. The problems and conditions encountered in spaceflight and exploration have created unprecedented instrumentation requirements. Some of these include extraterrestrial life detection, trace contaminant monitoring in a close environment, orbital docking, physiological measurements, communication problems, etc. Many astronaut tasks can be most economically performed only by very careful man-machine integration. The astronaut's sensory input channels are overloaded making desirable a communication scheme whereby the external sensors are bypassed en route to the central nervous system. Understanding the various sensory systems offers possibilities of using standard sensory channels in different or unorthodox ways. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-19832 Radio Corp. of America, Camden, N. J. Applied Research.
THERMOELECTRIC WATER RECLAMATION FOR MANNED SPACE VEHICLES
P. E. Wright *In its* Space Electron. [1965] p 21–23 refs (See N66-19827 10-31)

One of the life-support problems for manned satellites and rocket trips through space is drinking water storage and handling. Discussed herein is a practical method for reclamation of drinking water from urine by use of thermoelectrics, including both theory of operation and data from working models. Author

N66-19878# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.
A HEATED MANIKIN FOR STUDIES ON AIR VENTILATED CLOTHING
D. Mc K. Kerslake Nov. 1964 20 p refs
(FPRC/MEMO-214) CFSTI: HC $1.00/MF $0.50

Described is the design and construction of a heated manikin for the investigation of the thermal insulation of clothing assemblies. The manikin is divided into 18 sections, each containing a heater and temperature sensing devices stuck to the inner surface of the shell. Heat output for each section is controlled by varying the duty cycle of the heater in accordance with a reference potential which cyclically scans the operating temperature of its section. The proportion of the scanning cycle, and therefore of the total time, during which the heater is switched on is a linear function of the local skin temperature. Where the design curve consists of more than one straight line two control systems are ulitized. Numerical values for different sections of the figure are presented in a table. G.G.

N66-19988# Radio Corp. of America, Camden, N. J. Defense Electronic Products.
LIFE SCIENCES
1965 53 p refs
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8. SPEECH RECOGNITION USING ARTIFICIAL NEURONS M. B. Herscher and T. B. Martin p 36-41 refs (See N66-19996 10-05)

N66-19989# Radio Corp. of America, New York.
BIOMEDICAL ENGINEERING
Alfred N. Goldsmith *In its* Life Sci. 1965 p 2-7 (See N66-19988 10-05)

The growing importance of biomedical engineering is emphasized, and this recent addition to the technological professions is defined as a cross-disciplinary branch of engineering, applying the skills and capabilities of modern electronics to the fields of biology, medicine, and surgery. The problems involved are assessed, and the role of sophisticated electronic devices in studying and sustaining life is examined. Instrumentation for measuring blood flow, blood velocity, respiration rates and the carbon dioxide cycle in breathing, eye movement, and body cavity pressures are discussed. Data on laser applications, patient supervision, prosthetics, computer applications for biomedical research, genetic studies and selective breeding, and biomedical instruction are reviewed, and the contributions of biology to engineering are summarized. M.G.J.

N66-19990# Radio Corp. of America, Princeton, N. J. Astro-Electronics Applied Research Lab.
ELECTRONICS TECHNOLOGY IN MEDICINE—A STATE OF THE ART REVIEW
Leslie E. Flory *In its* Life Sci. 1965 p 8-12 refs (See N66-19988 10-05)

Reviewed herein is the state-of-the-art of medical electronics, including the techniques and instruments now in use in areas of medicine that can be classified as heart engineering, nerve-system engineering, physiological monitoring, prosthetic devices, and medical repairs. In addition to present capability, some current problems and limitations are pointed out that need the attention of electronics engineers. A reference bibliography to some of the extensive literature in the field is included. Author

N66-19991# Radio Corp. of America, Princeton, N. J. Astro-Electronics Applied Research Lab.
MICROCIRCUIT-MICROWATT DESIGN TECHNIQUES FOR NEW INTERNAL MEDICAL SENSORS
Fred L. Hatke and Leslie E. Flory *In its* Life Sci. 1965 p 13-15 refs (See N66-19988 10-05)

Improved techniques for measuring physiological functions are discussed. Particular emphasis is given to the development of microcircuit-microwatt internal sensors, in which a small but relatively insensitive transducer is combined with some electronic gain inside the body to achieve overall system sensitivity. Details are given on a passive telemetering system, and schematics are included on a transistorized 2 Mc passive capsule system, a passive biological potential capsule, and a simplified passive biological potential capsule. Pressure and temperature sensors are discussed, and the operation of a voltage sensor is described. M.G.J.

N66-19992 Radio Corp. of America, Camden, N. J. Broadcast and Communications Products Div.
DEVELOPMENT OF ELECTRON MICROSCOPY IN THE LIFE SCIENCES
J. H. Reisner *In its* Life Sci. 1965 p 16-19 (See N66-19988 10-05)

The historical development of the electron microscope is reviewed, and its capabilities for providing information about the size, shape, and density of biological entities, and about their structural relationships, are discussed. The problems of applying electron microscopy in the life sciences are examined, and major developments in specimen preparation are listed. Instrument improvements, necessitated by improved specimen techniques, are discussed, along with the engineering developments which have resulted in simplified operation. The microscopist's functions are defined, and the need for adequate personnel training is stressed. The potential is assessed, with the application of television techniques to the microscope image identified as being particularly promising. M.G.J.

N66-19993# Radio Corp. of America, Camden, N. J. Broadcast and Communications Products Div.
ELUCIDATION OF ULTRASTRUCTURE WITH THE ELECTRON MICROSCOPE
John W. Coleman *In its* Life Sci. 1965 p 20-23 refs (See N66-19988 10-05)

Some examples of research in ultrastructure are given, with ultrastructure defined as the probable three-dimensional molecular arrangement of biomatter in a functional thermodynamic system. The use of the electron microscope as a practical observation tool is discussed, and it is pointed out that this instrument can, in principle, resolve macromolecular geometry even to the level of the primary structure. The problems of preparing specimens with ultrastructure intact are stressed, and some representative studies are cited. These include research on cellular substances, biological membranes, parts of cells, the total cell, and viruses. Summarized data are also presented on an investigation of the ultrastructure of T6 bacteriophage, using the electron microscope and selected area electron diffraction. M.G.J.

N66-19994# Radio Corp. of America, Princeton, N. J. RCA Labs.
ADAPTATION THEORY. A TUTORIAL INTRODUCTION TO CURRENT RESEARCH
Jack Sklansky *In its* Life Sci. 1965 p 24-30 refs (See N66-19988 10-05)
(Contracts AF 33(657)-11336; AF 33(615)-1764)

This paper introduces the concepts of adaptation theory, and then discusses the particular class of adaptive process on which work has concentrated—that of the threshold learning process and Markov chains, and the specific mathematical techniques associated with it. Included are some results on learning waves, feedback-adaptivity relationships, and learning times, as well as mention of some as-yet-unexplained phenomena. Some directions of future work are discussed, and a reference bibliography is included. Author

N66-19995# Radio Corp. of America, New York. Systems Lab.
NEURAL, THRESHOLD, MAJORITY, AND BOOLEAN LOGIC TECHNIQUES. A COMPARATIVE SURVEY
Charles R. Atzenbeck and Daniel Hampel *In its* Life Sci. 1965 p 31-35 refs (See N66-19988 10-05)

This paper presents the basic characteristics and relative merits of the four types of logic classified (in decreasing order of complexity) as neural, threshold, majority, and Boolean, and considers combinational switching functions, logic configurations and synthesis, and factors in circuit realization. Although the mathematics of synthesis and component choice for neural logic are not today as well defined as for Boolean or threshold logic, present work indicates that future neural network systems should be not only feasible but also competitive with Boolean or threshold logic. Author

N66-19996# Radio Corp. of America, Camden, N. J.
SPEECH RECOGNITION USING ARTIFICIAL NEURONS
M. B. Herscher and T. B. Martin *In its* Life Sci. 1965 p 36-41 refs Sponsored by AF (See N66-19988 10-05)

This paper describes basic speech analysis techniques, and presents results for consonants in the fricative, liquid, semivowel, and nasal class. Also described is the acoustic analyzer built with analog-threshold-logic networks of direct-current neurons (as opposed to pulse-type neurons). While results correspond closely to previous speech studies, a significant deviation was in the features utilized for recognition of individual phonemes—primarily spectral regions of increasing and decreasing energy, found relatively invariant and machine recognizable. Future goals include recognition of continuous speech through higher-level neural logic based on linguistics and context. Author

N66-20050*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
[STUDY OF FEED BACK CONTROL SYSTEMS IN THE DEVELOPMENT OF MANIPULATORS AND REMOTE TOUCH SENSORS] Progress Report, 1 Apr.-30 Sep. 1965
28 Jan. 1966 12 p refs
(Grant NsG-107-61)
(NASA-CR-70782; SA-9991-4) CFSTI: HC $1.00/MF $0.50 CSCL 06D

Progress is reported on studies in the following categories: development of a spatially continuous remote touch sensor; force feedback with delay; simulation study of supervisory control of a manipulator using entirely computer simulated task for the human operator; simulation study of supervisory control of a manipulator using an actual manipulator and mechanical environment; and dynamic programming model of preview control. M.R.W.

N66-20066*# Melpar, Inc., Falls Church, Va.
HUMAN PERFORMANCE CONTROL MONITORING SYSTEMS Interim Report No. 2
J. M. Gervinski and R. E. Mirabelli 15 Jan. 1966 28 p
(Contract NASw-1085)
(NASA-CR-71036) CFSTI: HC $2.00/MF $0.50 CSCL 06B

The basic features of a computer program for a human performance and monitoring system are described. This program provides the option of being in the automatic or manual control mode at any time; it simulates a second-order servo plant and incorporates a controller made from adaptive logic elements. Preliminary results indicate the systems dynamics are working correctly and the controller is trainable. G.G.

N66-20071*# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
RESEARCH ON NEW TECHNIQUES FOR THE ANALYSIS OF MANUAL CONTROL SYSTEMS Progress Report, Jun. 15-Dec. 15, 1965
George A. Bekey [1965] 23 p refs
(Grant NGR-05-018-022)
(NASA-CR-71196) CFSTI: HC $1.00/MF $0.50 CSCL 05H

Fabrication and acquisition of experimental equipment for analytical studies of manual control systems are reported, and details of simulation cockpit and data processing components are given together with outlines of four analytical and computer investigations. Studied were: (1) Random parameter models of human controllers; (2) development of finite state machines as models for manual tracking; (3) identification procedures for unknown sampling frequency in sampled-data models of human operators; and (4) development of software for models of manual on-off control. G.G.

N66-20132*# Texas Univ., Austin. Defense Research Lab.
[CONDUCT STUDIES OF AUDITORY INFORMATION PROCESSING EMPHASIZING THE APPLICATION OF SIGNAL DETECTABILITY THEORY TO THE AUDITORY SENSORY RESPONSES] Semiannual Report (Sixth Quarterly Status Report), 1 Jun.-30 Nov. 1965
L. A. Jeffress and C. S. Watson 11 Feb. 1966 9 p
(NASA Order R-129; Contract Nonr-3579(04))
(NASA-CR-70926) CFSTI: HC $1.00/MF $0.50 CSCL 05H

Progress is reported on auditory information processing studies emphasizing the application of signal detectability theory to the auditory sensory responses. A new facility for studying auditory detection and its autonomic concomitants was completed. A new psychophysical method was developed to analyze vigilance performance in terms of the signal detectability theory. The data collection phase of initial experiments concerning adaptation effect on the brightness of flashed incremental and decremental stimuli is complete. A set of low pass and high pass filters were mounted for use. They permit generating band pass filters with high and low frequency cutoffs at various locations relative to the signal frequency. The signal detectability theory has not so far developed a mathematical model to account for the relative invariance of the measure of detectability, d', with signal duration when signal energy is kept constant. Experiments with an electrical model using a narrow filter followed by an envelope filter and detector showed preference for signal duration which is the receptrocal of the filter bandwidth. R.N.A.

N66-20174# RAND Corp., Santa Monica, Calif.
WEIGHTS OF ENVIRONMENTAL-CONTROL SYSTEMS
Stephen H. Dole Jan. 1966 7 p Presented at the 4th Ann. Meeting of the Working Group on Extraterrest. Resources, Colorado Springs, 1 Dec. 1965
(P-3297; AD-626680) CFSTI: HC $1.00/MF $0.50

Generalized relationships are presented that can be used for estimating the weights of environmental-control equipment and expendables required for supporting human beings on space missions. Dry weight was defined as including breathing-gas supply, carbon dioxide removal, humidity control, trace contaminants removal, fresh water supply, thermal control, and waste management. The equation derived for dry weight (W_D) was: $W_D = 117\ N^{0.58}T^{0.33}N^{0.11}$, where N is the number of men in the crew and T is the unresupplied duration of the mission in days. The expression produced dry weights within ±20% of those obtained from 23 contractors' reports in all but 2 instances. Total weights were estimated by adding weights of expendables to dry weights. The total weight (W_T) expression was $W_T = W_D + N(19T^{1/2} + 2T)$. The total weight estimates were generally within ±40% of those obtained from contractors' supports. TAB

N66-20573# Naval School of Aviation Medicine, Pensacola, Fla.
TOWARD AN OPTIMAL METHOD OF EQUATING SUBGROUPS COMPOSED OF DIFFERENT SUBJECTS
Robert J. Wherry, Jr. 4 Aug. 1964 103 p refs *Its* Monograph no. 9
(AD-627258) CFSTI: HC $4.00/MF $0.75

Whenever two or more individuals are to be compared on the basis of scores obtained from different evaluators, certain differential non-equivalence errors should be removed from their scores. A rationale for understanding how these non-equivalence errors affect a set of scores is presented. Various non-equivalence errors such as 'leniency,' 'exaggeration,' 'floor and ceiling,' 'differential treatment of extremes,' and various 'composition' effects such as differential emphasis of factors, reliability, and validity are included in the rationale. The confounding effect of differential spread of ability and differential average ability among subgroups is discussed. The problem of optimally removing non-equivalence errors involves finding the best variable or composite of variables to use as a 'standardization' variable against which the data from different evaluators may be equated. Two methods for accomplishing this goal are described. The superiority of a nonlinear solution, rather than a linear solution was demonstrated. Cross validation results are also presented. Author (TAB)

N66-20642# Naval Air Development Center, Johnsville, Pa.
RESPONSE DURATION AND INTERRESPONSE TIME UNDER FR5 AND VR5 SCHEDULES AND SUBSEQUENT EXTINCTION
Robert M. Herrick 8 Nov. 1965 19 p refs
(NADC-MR-6505; AD-625324) CFSTI: HC $1.00/MF $0.50

With respect to press duration, t, and interresponse time, i, rats under FR5 and VR5 schedules and subsequent extinction behaved similarly. During acquisition days, mean t and mean i decreased, and mean response rate increased. Compared with acquisition, in extinction (a) the relative frequency of short t's decreased, (b) either the relative frequency of short is decreased or the relative frequencies of both short and long is increased. Variations in several central tendency and variability measures of t and i within the first extinction day were greater than variations within the last acquisition day. Median duration of the first press or of the first interresponse time following water-dipper operation was relatively long ('postreinforcement pause'). Thereafter, both median t and median i, as function of ordinal number following dipper operation, tended to remain relatively constant. Within an FR5 or VR5 cycle, response rate changed abruptly from zero to a constant rate. During extinction, periods of responding at a normal or slighly subnormal rate alternated with periods of little or no responding. Author (TAB)

N66-20695# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
DISTRICT BIOLOGICAL MONITORING AT A.E.R.E., HARWELL: RESULTS FOR 1963 AND 1964
A. Morgan, A. Homes, H. D. Vandervell, and W. L. Brooks Nov. 1965 23 p refs
(AERE-R-5015) HMSO: 3s

The results of measurements made during 1963 and 1964 on samples of milk, soil, mat and herbage collected in the vicinity of the Atomic Energy Research Establishment are described. Levels of strontium-90 and cesium-137 in milk, sampled at six farms within three miles of A.E.R.E., were no greater than would be expected from world-wide fallout and, at most, only correspond to about 5 and 3 per cent of the respective derived working limits, appropriate for members of the public living in the neighborhood of controlled areas. Levels of iodine-131 in milk remained below the limit of detection (20 pCi/litre) throughout this period. Measurements of strontium-90 and cesium-137 in soil, mat and herbage, collected at a number of sites within three miles of A.E.R.E., showed that the total deposition of these fission products could be accounted for by fallout from the testing of nuclear weapons. It may be concluded that operations at A.E.R.E. have not affected significantly the levels of radioactive contamination in its immediate neighborhood. Author

N66-20700# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
THE ADVANCED COURSE IN THE PRINCIPLES OF RADIATION PROTECTION, PART I
W. J. Whitehouse and E. D. Dyson Nov. 1965 28 p refs
(AERE-R-5084) HMSO: 3s 6d

This report reviews the background, history and initial organization of the courses, and summaries their subject matter, including lectures, practical work, visits, and films. The reasons for arranging and presenting the courses, in the way that was adopted, are discussed. Author

N66-20717# Stanford Univ., Calif.
THE RESPONSES OF SIMULATED DETACHED RETINA TO VARIOUS DYNAMIC FORCES
John W. Silvis (M.S. Thesis) Aug. 1965 32 p refs
(Contract AF 33(608)-1278)
(AD-624662) CFSTI: HC $2.00/MF $0.50

The experiments suggest that the application of rotational vibrations and/or the application of approximately a 2G force field could greatly enhance the natural settling of a detached retina in the clinical case and give a firm reattachment around the tear, eliminating the need for surgical intervention. The model studies to date substantiate the feasibility of a migratory reattachment under rotational vibration and/or centrifugal forces and justify proceeding with the next phase of the research project—that of completing the model centrifugal tests and then studying the response of detached retinas in animals by rotational vibrations and/or centrifugal forces including the effectiveness of various osmolar agents on migratory settling. Author (TAB)

N66-20825# Naval Training Device Center, Port Washington, N. Y.
AN EVALUATION OF VARIOUS TACHISTOSCOPIC AND WEFT TECHNIQUES IN AIRCRAFT RECOGNITION Final Report
Edward I. Gavurin Nov. 1965 28 p refs
(NAVTRADEVCEN-IH-40; AD-626468) CFSTI: HC $2.00/MF $0.50

The study evaluated some of the basic assumptions, techniques and procedures underlying current aircraft recognition training. The effectiveness of the WEFT (analytical) vs. the tachistoscopic approach to training, the relative merits of a successive vs. a simultaneous presentation of stimuli, and the role of image exposure time were investigated. Recommendations for current training and additional research are included. Author (TAB)

N66-20833# Air Force Systems Command, Bedford, Mass. Electronic Systems Div.
IMMEDIATE RETRIEVAL OF VERBAL SERIES AS A FUNCTION OF STIMULUS GROUPING

William H. Sumby Oct. 1965 21 p refs
(ESD-TR-64-554; AD-627260) CFSTI: HC $1.00/MF $0.50

Four questions were investigated. (1) Is the learning rate enhanced if disconnected words are presented visually in clusters, e.g., pairs of quadruples, rather than individually and successively? (2) If changes do occur, and in a lawful fashion, can such differences be accounted for adequately in terms of the development of differential inter-item association strengths as a function of such stimulus arrangement? (3) What differences, if any, become evident in free-recall serial position curves by such organization? (4) How is the order of responding affected by the clustering? It was found that clustering will enhance learning rate, but that the limits are extremely restricted. It was revealed that such stimulus arrangements do affect the buildup of differential inter-item association strengths, but this again is within the limits alluded to above. Apparently, differential associative strengths developed by clustering markedly affect the shapes of the serial position curves for the different groups. Clustering affects the strategy an individual adopts in responding. Such became evident in the typically different orders of responding for the various conditions.
Author (TAB)

N66-20858# George Washington Univ., Washington, D. C. Human Resources Research Office.
SHORT-TERM MEMORY: AN ANNOTATED BIBLIOGRAPHY
Donald Reynolds and Richard D. Rosenblatt Dec. 1965 83 p refs
(Contract DA-44-188-ARO-2)
(HUMRRO-TR-65-13; AD-627394) CFSTI: HC $3.00/MF $0.75

The bibliography is divided into 12 areas as follows: (1) Information Theory; (2) Proactive and Retroactive Interference and Interpolated Activities; (3) Set, Subject-Strategies, and Coding Techniques; (4) Paired-Associate Studies; (5) Simultaneous Listening and Memory Span Studies; (6) Rate and Mode of Stimulus Presentation; (7) Rate and Order of Recall, and Serial and Sequential Tasks; (8) Methods, Theory, and Review Articles; (9) Meaningfulness, Degree of Learning, and Stimulus Organization; (10) Age Differences; (11) Comparisons of Short-Term Memory and Long-Term Memory; and (12) Perceptual Studies. There are 170 articles annotated in the bibliography and extensive cross-indexing to facilitate location of articles. Although the earliest study included is dated 1910, the majority of articles were published in the period from 1959 through 1964.
Author (TAB)

N66-20880# Washington Univ., St. Louis, Mo. Dept. of Environmental and Sanitary Engineering
WATER RECOVERY FROM HUMAN LIQUID WASTES BY DISTILLATION AND CHEMICAL OXIDATION
Michael James Ryan (M. S. Thesis) Jan. 1966 116 p refs
(Contract AF 33(608)-1292)
(AD-624671) CFSTI: HC $4.00/MF $0.75

The recovery of potable water from human urine by atmospheric and vacuum distillation and by chemical oxidation was investigated utilizing the parameters of organic carbon, BOD, and COD. Linear relationships existed between organic carbon, BOD, and COD for the human urine samples studied. These relationships were as follows: organic carbon to BOD ratio equals 1.34, BOD to COD ratio equals 0.52, and organic carbon to COD ratio equals 0.64. The vacuum distillation of urine yielded a water suitable for human consumption. The chemical oxidation of human urine by ozonation was not found to be a practical means of treatment and water recovery due to the excessive quantities of ozone required.
Author (TAB)

N66-20884# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GRAPHICS Semiannual Technical Summary Report, 1 Jun.–30 Nov. 1965
Jack I. Raffel 30 Nov. 1965 15 p refs
(Contract AF 19(628)-5167; ARPA Order 691)
(ESD-TDR-65-561; AD-625567) CFSTI: HC $1.00/MF $0.50

Recent efforts in the Graphics Program have concentrated on the development of a Graphical Service System, display routines compatible with the new time-sharing system, APEX, and a universal translator, VITAL, which will be used to generate a graphical compiler. Programs for clipping and approximating conic segments have been developed and initial experiments which apply graphical techniques to procedure description have been attempted.
Author (TAB)

N66-21007*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DESIGN AND FABRICATION OF A TRACE CONTAMINANT REMOVAL SYSTEM FOR APOLLO Phase I Report, 1 Sep. 1964–15 Mar. 1965
15 Mar. 1965 237 p refs
(Contract NAS9-3415)
(NASA-CR-65278; M-58-65-1) CFSTI: HC $6.00/MF $1.25 CSCL 06K

Eighty-eight potential spacecabin trace contaminants were classified according to method of removal. Candidate sorbents and catalysts were selected and subjected to experimental evaluation. A Polanyi potential plot for the prediction of charcoal adsorption was developed experimentally, under Apollo cabin atmosphere conditions. Acidic and basic sorbents, a solid oxidant, and catalysts were experimentally evaluated for removal and/or conversion of contaminants shown by the potential plot not to be adsorbed on a specified amount of charcoal. Experimental data described above were used to develop an optimum contaminant removal system. This system was designed in detail, and test planning was accomplished in sufficient depth to begin the second phase of the program.
Author

N66-21015*# Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.
UNMANNED EXTRAVEHICULAR ENVIRONMENTS OPERATION QUALIFICATION TEST OF THE GEMINI ELSS (EXTRAVEHICULAR LIFE SUPPORT SYSTEM) Test Plan
F. H. Goodnight and T. E. Mouritsen 10 Sep. 1965 73 p refs
Its Rept.-00.690
(Contract NAS9-3414)
(NASA-CR-65279) CFSTI: HC $3.00/MF $0.75 CSCL 06K

The test plan for the unmanned portion of the extravehicular environments operation qualification test program for the Gemini Extravehicular Life Support System (ELSS) is described. The test facility, special equipment, and instrumentation are also described. Simulation of environments will include: (1) vacuum, (2) solar radiation at 1 solar constant, (3) heat sink of deep space, and (4) simulation of crewman metabolic sensible and latent heat loads. The plan calls for the unit to be subjected to normal operational modes up to the unit's design limits and to the following simulated failures: (1) umbilical failure, (2) simulated suit penetration, and (3) heat exchanger failure. Test data will be recorded during the testing, to provide documentation of acceptable operation of the system within specified parameters. The data processing and check procedures and test procedures to be used are also discussed.
L.S.

N66-21016*# Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.

THERMAL PERFORMANCE TEST OF THE A-2H APOLLO EXTRAVEHICULAR MOBILITY UNIT, VOLUME I

F. G. Goodnight, R. O. Pearson, and R. J. Copeland 15 Mar. 1965 393 p refs *Its* Rept.-00.638
(Contract NAS9-3414)
(NASA-CR-65280) CFSTI: HC $7.00/MF $2.00 CSCL 06K

The results and analyses of the results of three experiments, II-a, II-b, and II-c, of a series of twelve space suit thermal evaluation tests performed to evaluate the performance and thermal response of an Apollo Extravehicular Mobility Unit (space suit), EMU, in space and lunar environments are presented. The test facility, equipment, instrumentation, test procedures, data recording, and test variances are described and discussed. The experiments subjected a prototype Apollo EMU containing a thermal dummy to low pressure and simulated extreme thermal environments of space and the lunar surface. Test objectives included determination of suit temperatures and pressures as a function of time, heat load, and position; net suit heat gain or loss; effects of suit contact with spacecraft surfaces; suit gas leakage; and other objectives. Simulation of the thermal and pressure environments during the tests included astronaut body temperatures, a deep space heat sink, solar heat flux, lunar surface radiation, hot and cold spacecraft surfaces, vacuum, and a portable life support system. Photographs of the dummy, test setups, and equipment are presented, along with tables of data, and graphs. L.S.

N66-21019*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

DESIGN AND FABRICATION OF A TRACE CONTAMINANT REMOVAL SYSTEM FOR APOLLO Phase II Report, Mar.–Sep. 1965

23 Nov. 1965 116 p refs
(Contract NAS9-3415)
(NASA-CR-65299; M-58-65-2) CFSTI: HC $4.00/MF $0.75 CSCL 06K

The hardware designed was constructed and evaluated. The evaluation was done in three steps: (1) a bench test of the main sorbent canister alone, (2) a bench test of the catalytic oxidizer—post sorbent assembly, and (3) the closed-chamber testing of the complete system under simulated Apollo cabin atmosphere conditions in a 200 ft^3 volume. In this report the hardware is described, together with the test procedures, apparatus, and results. The installation of the contaminant removal system in the Apollo Command Module is described, together with the additional hardware development required prior to entering the flight qualification phase. Author

N66-21020*# AiResearch Mfg. Co., Los Angeles, Calif.

PERFORMANCE EVALUATION TEST RESULTS: SPACECRAFT CABIN MOISTURE-REMOVAL SYSTEM 630275-1

V. Vidugiris 20 Oct. 1965 58 p ref
(Contract NAS9-4238)
(NASA-CR-65286; SS-3929) CFSTI: HC $3.00/MF $0.50 CSCL 06K

Performance evaluation tests were conducted to determine the performance of a spacecraft regenerable cabin moisture-removal system under 14-day spacecraft mission simulation, with varying moisture injection rates. All of the test objectives, i.e., the determination of 1) the amount of moisture that the system adsorbs, (2) dew points in and out of the system and the cabin dew-point profile, (3) bed temperatures as a function of time, (4) cycle-time effects, and (5) extended cycling effects were met, and the results are presented. Numerous graphs are given; and schematic diagrams for the cabin moisture-removal system, for the pressure transducer and dew-point analyzer installation, and thermocouple installation are shown, along with photographs of various parts of the test setup. L.S.

N66-21098*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

REVIEW OF RESEARCH AND METHODS FOR MEASURING THE LOUDNESS AND NOISINESS OF COMPLEX SOUNDS

Karl D. Kryter Washington, NASA, Apr. 1966 59 p refs
(Contract NASw-1102)
(NASA-CR-422) CFSTI: HC $0.85/MF $0.50 CSCL 05E

A detailed review of the research and concepts underlying the evaluation of the subjective attributes of the loudness and noisiness of complex sounds is presented. Knowledge about the attribute of loudness has reached the stage where two procedures for the calculation of the loudness of a complex sound from purely physical measurements (octave, one-half octave, or one-third octave band spectra) were proposed for standardization on an international basis. The methods are those proposed by Stevens and by Zwicker. It is proposed that the perceived noisiness or "unwantedness" of a sound is more important to the evaluation of man's noise environment than is loudness. The following physical and temporal aspects of a sound, listed in order of importance, were found to influence how people will in general rate its subjective noisiness: (1) intensity level, (2) spectrum shape and bandwidth, (3) spectral complexity (presence of one or more pure tones in a band of random noise), and (4) duration. Various methods were developed for calculating the perceived noisiness of complex sounds from either one-third octave or full octave band spectra. National and international standards were proposed to use perceived noise level in PNdB for the evaluation of aircraft noise. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-19796# Cekmece Nuclear Research Center, Istanbul (Turkey).

KINETICS OF THE REACTION OF TETRACHLORO-P-BENZOQUINONE WITH TRI-N-DODECYL AMINE

M. Talât-Erben and Güngör Dinçler Oct. 1965 15 p refs
(CNAEM-30) CFSTI: HC $1.00/MF $0.50

The kinetics of the reaction of chloranil with tri-n-dodecyl amine have been investigated in the temperature range 100–115.5° C and in the concentration range 0.036–0.0697 M. The kinetics follow a simple second-order mechanism. The energy of activation is 19.7 Kcal./mole. The reaction product is a quaternary ammonium salt, (trichloro-p-benzoquinonyl)-tri-n-dodecyl ammonium chloride. The rate constant is given by: $k = 5.74 \times 10^{10} \exp(-9950/T)$ $(minute)^{-1}$ $(mole)^{-1}$. Author

N66-19803# Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

ON THE FINE STRUCTURE OF THE NUCLEAR MAGNETIC RESONANCE SPECTRA OF CERTAIN DERIVATIVES OF BENZODIOXAN [SULLA STRUTTURA FINE DEGLI SPETTRI RISONANZA MAGNETICA NUCLEARE DI ALCUNI DERIVATI DEL BENZODIOSSANO]

P. L. Indovina and V. Rosnati 16 Nov. 1965 43 p refs In ITALIAN; ENGLISH summary

(ISS-65/44) CFSTI: HC $2.00/MF $0.50

In this work, the Nuclear Magnetic Resonance spectra of a series of 2-2 disubstituted Benzodioxan derivatives were examined. Certain of these exhibit a fine structure which cannot be interpreted in terms of a spin-spin interaction of the second order. Spectra at various temperatures help to explain the phenomenon in terms of the existence of conformational isomers of the derivatives of Benzodioxan. The temperature dependence makes it possible to calculate the order of magnitude of the activation energy which separates the two conformational iosmers. From the values of the coupling constant between the non-substituted protons of the methylene, protons which give rise to an AB system, it is possible to calculate the angle between the two CH bonds according to the usual theory of Karplus. Author

N66-19826# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Chemistry Research Lab.

THE APPLICATION OF CALCULATION OF ION SOURCE SYSTEMS AND ION ENERGY SPREAD TO SOME OF THE PROBLEMS OF ION–MOLECULE INTERACTIONS

K. R. Ryan and J. O. Terry Aug. 1965 33 p refs

(ARL-65-170; AD-626978) CFSTI: HC $2.00/MF $0.50

Calculations are described which were designed to support an experimental attempt to measure the specific reaction rate for typical ion–molecule reactions as a function of reactant ion energy. The time averaged specific reaction rate k is given by $k=Is/(Ip+Is)B\tau$ where Ip and Is are the concentration of the reactant ion and secondary ion respectively, B the concentration of neutral products and τ the total time for reaction. One possible instrument for measuring this energy dependent rate constant is a mass spectrometer. These calculations show that it is possible to obtain a small spread in the kinetic energy of the ions formed and then to measure the energy dependent rate constant. The source residence time for ions in mass spectrometer used is calculated, and the energy spread of the ion beam produced by a 20 nanosecond ionizing pulse was then computed for many conceivable experimental conditions. Author (TAB)

N66-19902* Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.

CHANGE IN THE THERMIONIC EMISSION CURRENT OF PALLADIUM DUE TO CHEMISORPTION OF ATOMIC AND MOLECULAR HYDROGEN

Melvin M. Eisenstadt (Ph.D. Thesis) *In its* Detection Tech. for Tenuous Planetary Atmospheres [1966] 165 p refs (See N66-19901 10-23) CFSTI: HC $6.00/MF $1.25

The thermionic emission current from a palladium filament at 1000°C was measured while the filament was exposed first to a molecular hydrogen beam and then to a beam of atomic hydrogen. The source of the beams was a tungsten–rhenium tube in an ultra high vacuum system. Molecular hydrogen was used at room temperature and atomic hydrogen was obtained by thermal dissociation of the beam at 2400°K. The thermionic emission increases as the beam intensity increases for both H and H_2 which indicates a decreasing work function. This decrease in work function was greater during molecular beam operation than atomic beam operation and is attributed to a difference in sticking coefficients of H and H_2 on palladium, with atomic hydrogen lower than molecular hydrogen by a factor of 1/2. This difference is attributed to the mechanism of energy exchange between the gas and the metal lattice during a collision. The slower moving molecules transfer enough kinetic energy to the palladium lattice so that they can be adsorbed while the more energetic atoms tend to rebound. Although molecular hydrogen must dissociate before chemisorbing, it was found the dissociation was not rate determining. E.A.O.

N66-19904# Nuclear Metals, Inc., Concord, Mass. Physical and Chemical Metallurgy Dept.

PREPARATION OF STANDARD SAMPLES AND DEVELOPMENT OF ANALYTICAL TECHNIQUES FOR CARBON AND NITROGEN IN HIGH-PURITY BERYLLIUM

L. R. Aronin, F. A. Bauman, and A. K. Wolff Wright-Patterson AFB, Ohio. AF Mater. Lab., Oct. 1965 50 p refs

(Contract AF 33(615)-1692)

(NMI-9703.4; AFML-TR-65-195; AD-626987) CFSTI: HC $2.00/MF $0.50

Analytical techniques have been developed for the determination of carbon in high-purity beryllium. The method, a modification of the combustion-conductometric technique, permits an increase in the sample size of about four times, thereby achieving a fourfold reduction in the lower limit of useful analytical results. Sensitivity has been demonstrated for carbon contents as low as 25 ppm. The accuracy of a solution distillation technique for determination of nitrogen in high-purity beryllium has been established. A modified micro-Kjeldahl still was employed. Nitrogen contents less than 10 ppm can be accurately determined. Three batches of beryllium weighing roughly 5 pounds each have been prepared. Each batch was attritioned, sized and blended to provide a homogeneous material for analytical standards. These standards, in the form of coarse chips, have the following carbon and nitrogen contents for the 3 standards in parts per million, respectively: carbon, 25, 101, and 120 and nitrogen, 11, 55, and 56. TAB

N66-19906# Sheffield Univ. (England).

STUDIES IN THE HALOGENATION OF ALIPHATIC COMPOUNDS

J. M. Tedder, I. Galiba, and H. Singh Wright-Patterson AFB, Ohio. ASD, Oct. 1965 128 p refs

(Grant AF-EOARDC-61-7)

(ASD-TR-63-155; AD-626758) CFSTI: HC $2.00/MF $0.50

The relative rates of the gas phase chlorination of n-hexane at the primary and secondary positions were studied and a rate expression obtained. The chlorination and bromination of 1,1,1-trifluoropentane and 1-fluorobutane were studied in the gas phase using a static system. The reactions were studied at several temperatures and approximate values of the Arrhenius parameters for attack at each site in the molecules were obtained. The results confirm earlier work and show that the CF_3 group exerts a very powerful deactivating effect on halogenation at adjacent sites. The chlorination and bromination of n-valeryl fluoride chloride and methyl valerate were studied in the gas phase using a static system. The acyl group deactivates halogenation at adjacent methylene groups, but to a lesser extent at the alpha-position than would be expected on purely polar grounds. The gas phase reaction of fluorine and carbon tetrachloride with nitrogen as a diluent was

studied in a flow system. The extent of reaction was followed by determining the halide formed when unchanged fluorine and any fluorine monochloride produced was converted into hydrogen fluoride and hydrogen chloride. Author (TAB)

N66-19955# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.

ELUCIDATION OF ^{11}BORON NUCLEAR MAGNETIC RESONANCE SPECTRA BY HETERONUCLEAR SPIN DECOUPLING

G. D. Vickers, H. A. Schroeder, H. Agahigian, and E. A. Pier Jan. 1966 11 p refs
(Contract Nonr-3395(00))
(TR-29; AD-625749) CFSTI: HC $1.00/MF $0.50

It is indicated that heteronuclear spin decoupling does aid the evaluation of ^{11}boron spectra in that the information obtained is compatible with the information obtained from the 64.2 Mc/sec. spectra. It is noted that these spectral evaluations might suggest an unexpected consideration pertaining to spectral assignments. Both the ortho and meta isomers have one pair of equivalent boron nuclei more intimately neighbored to carbon than the four equivalent boron nuclei, and two pair of equivalent boron nuclei further removed from carbon than the four equivalent boron nuclei. This suggests that the spectra should have one doublet on one side of the resonance of the four equivalent boron nuclei and two doublets on the other side. In both cases, the doublet is at higher field than the resonance of the four equivalent boron nuclei, and the pair of doublets is at lower field. This seems to suggest that carbon could be imparting a diamagnetic shift to its neighboring boron nuclei. A paramagnetic shift would be expected if only relative- electronegativities were considered. TAB

N66-19962# Auburn Univ., Ala. Dept. of Chemistry.

A STUDY OF THE DECOMPOSITION MECHANISM OF AMMONIUM PERCHLORATE Quarterly Report, 1 Oct.–31 Dec. 1965

James E. Land [1966] 11 p
(Contract DA-01-021-AMC-12346(Z))
(QR-2; AD-626805) CFSTI: HC $1.00/MF $0.50

Efforts were concerned with: (a) a continuation of the making of DTA runs at various heating rates on ammonium perchlorate (AP) samples to which had been added various metal oxides to measure the catalytic effect of these additives; (b) performing DTA runs on AP samples to which had been added certain metal complexes of the ferrocene type, and (c) beginning a series of DTA runs on AP samples which have been doped with a known per cent of a metal perchlorate so as to determine the influence of this additive on the DTA exo- and endotherums recorded for AP decomposition as it is heated at various rates over a given temperature range. Author (TAB)

N66-20010# Army Foreign Science and Technology Center, Washington, D. C.

EFFECTS OF ADDITIVES ON ANTIWEAR AND ANTIFRICTION PROPERTIES OF POLYSILOXANES

M. I. Nosov and G. V. Vinogradov Dec. 1965 11 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 8, Aug. 1965 p 50–53
(FSTC-381-T65-553; AD-626078) CFSTI: HC $1.00/MF $0.50

The effect of some organic compounds containing sulfur, chlorine, and phosphorus on the lubricating action of polysiloxanes of various types under heavy friction loads were studied. Additives that show a high activity in preventing scoring of steel in hydrocarbon lubricating media were much less effective in polysiloxanes. Their activity decreased sharply on transition from polyethylsiloxane to polymethylsiloxane and then to polymethylphenylsiloxanes. They almost had no effect on the lubricating capacity of polymethylphenylsiloxanes. The assumption is made that the decomposition of well known additives, which determines their effectiveness in preventing scoring of steel, initiates chain reactions in which the principal components of lubricating oils participate. With increasing stability of lubricating media to reactions in which free radicals take part, the activity of additives that counteract scoring decreases. This explains the lack of effectiveness in polymethylphenylsiloxanes of the additives considered. Author (TAB)

N66-20029# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.

THE RADIOLYTIC REACTION BETWEEN GRAPHITE AND CARBON DIOXIDE. PART 6: GAS FLOW EXPERIMENTS IN DIDO, THE EFFECT OF ADDED OXYGEN

D. A. Dominey, H. Morley, and R. J. Waite Aug. 1965 25 p refs
(AERE-4988) HMSO: 3s

The addition of small amounts of oxygen to carbon dioxide accelerates the radiolytic oxidation of graphite. The effect is not directly proportional to oxygen concentration and it is probable that energy is transferred from CO_2 to O_2 in the gas phase and that graphite is oxidised by the resulting active species. The inhibiting action of $CH_4/CO/CO_2$ mixtures is destroyed by the addition of oxygen, not by desctruction of the methane itself but by removal of the protective layer formed on the graphite by decomposition of methane. Author

N66-20117# Rocketdyne, Canoga Park, Calif.

CALCULATION OF VIBRATIONAL FORCE CONSTANTS Final Report, 1 Dec. 1961–31 Aug. 1965

E. C. Curtis 31 Aug. 1965 29 p refs
(Contract AF 49(638)-1135)
(R-6293; AFOSR-65-1822; AD-625878) CFSTI: HC $2.00/MF $0.50

Better models are sought for the calculation of vibrational force constants of simple polyatomic molecules. An extensive system of computer programs were coded to aid in this work. Several models for force constants were examined and some new ones were developed. Force constants were calculated for several interesting molecules and in particular, molecules chosen to test the force constant models that were studied. Author (TAB)

N66-20147# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.

ELECTRIC-ARC FURNACE REDUCTION OF TIN SLAG FOR PRODUCTION OF COLUMBIUM-TANTALUM-BEARING ALLOY

Willard L. Hunter and Oliver C. Fursman 1966 28 p refs
(BM-RI-6734)

The smelting of tin slags was undertaken to produce crude columbium–tantalum ferroalloy as a unit operation in the production of pure columbium and tantalum oxides or chlorides. Tin slags were reduced by carbon in a small, single-phase, steel-making furnace, a larger three-phase, steelmaking furnace, and a three-phase, submerged-arc furnace. In all cases depleted slags were fluid and easily tapped from the furnace. However, unless diluted by iron additions, the metal product was a viscous, high-melting, heterogeneous mixture that could be removed from the furnace only by hand rabbling. In batch operations in the steelmaking furnaces, 90 percent of the columbium and 85 percent of the tantalum were recovered in the alloy. Although more than 90 percent of the columbium and tantalum were recovered by smelting tin slag

in a submerged-arc, ferroalloy furnace, removal of alloy from the furnace hearth was extremely difficult. Alloy produced when smelting tin slag in either type of furnace, without iron addition, possessed both physical and chemical properties required for further processing. Author

N66-20151# Frankford Arsenal, Philadelphia, Pa. Quality Assurance Directorate.

DETERMINATION OF CARBON BLACK AND GRAPHITE IN NITROCELLULOSE-BASE PROPELLANTS

Goerge Norwitz and Michael Galan Nov. 1965 39 p refs (T66-3-1; AD-627253) CFSTI: HC $2.00/MF $0.50

The entire problem of determining carbon black and graphite in nitrocellulose-base propellants was investigated. It is shown that available methods for the determination of carbon black leave much to be desired, especially if carbon black and graphite are both present. A new spectrophotometric method for the determination of carbon black in propellants is proposed that depends upon the yellow color obtained when carbon black is dissolved by boiling with nitric acid. Improved gravimetric procedures are proposed for the determination of graphite in nitrocellulose-base propellants by the morpholine, nitric acid, and nitric-hydrochloric acid methods. Also described is an improved procedure for the determination of graphite and tin on the same sample. The results obtained for all the methods for graphite are compared. TAB

N66-20152# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STIMULATED RAMAN EFFECT OF SOME SUBSTANCES

M. Ye. Movseyan, Zh. O. Ninoyan, and L. T. Badalyan 21 Dec. 1965 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Arm. SSR (Erevan), v. 40, no. 4, 1965 p 205-207 (FTD-TT-65-1313/1+4; AD-627072) CFSTI: HC $1.00/MF $0.50

Spectra were obtained of the stimulated Raman effect of anisole, chlorobenzene, chloroprene, dichlorethane, acetophenone, acetylacetone, and chloroform. The source of the excitation in the stimulated combination scattering was a ruby generator of power pulses which operated in an accumulation system. The spectra of the stimulated Raman effect were recorded by the photographic method on the spectrograph ISP-51 with the camera UF-84. For acetophenone frequencies of 2 oscillations were observed, one of 997/cm and another of 3066/cm; this was observed also for chlorobenzene and anisole. A splitting of the Stokes lines was often observed, especially for xylols, with an unsplit stimulant. TAB

N66-20158# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.

A STUDY OF ELECTRODES AND ELECTRODE REACTIONS: I: THE ENERGY NECESSARY TO REMOVE AN OXYGEN MOLECULE FROM A CHARGED NICKEL OXIDE ELECTRODE IN A VACUUM

Benjamin C. Bradshaw Oct. 1965 22 p refs (ECOM-2637; AD-627248) CFSTI: HC $1.00/MF $0.50

The energies that are necessary to remove oxygen from the crystals that are on the surface of charged nickel oxide electrodes were calculated from the rates of evolution of oxygen from their surfaces into a vacuum. These energies increase in steps of about three kilo calories; this rate of increase is nearly the same as Bradshaw and Shuttleworth (Phys. Rev. v94 p753 1954) found for the physisorption of inert gases on the surface of various crystals. The energies of attachment of the oxygen to the nickel oxide crystals were used to calculate the half lives of the oxides on the surface of the charged nickel oxide electrodes. Author (TAB)

N66-20159# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDYING VULCANIZATION OF FLUORO-COPOLYMERS WITH POLYAMINES BY INFRARED SPECTROSCOPY METHOD

A. S. Novikov and F. A. Galil-Ogly 21 Dec. 1965 14 p refs Transl. into ENGLISH from Vysokomolekul. Soyedin. (Moscow), v. 4, no. 12, 1962 p 1799-1804 (FTD-TT-65-1371/1+2+4; AD-627005) CFSTI: HC $1.00/MF $0.50

It was found that the vulcanization of a hexafluoropropylene-vinylidene fluoride with hexamethylenediamine (HMDA) results in the formation of a HMDA-hydrofluoride salt (as a result of dehydrofluorination of the copolymer) and the formation of double bonds in the polymer chain which, in turn, join with a portion of the HMDA to form C=N and C=N bonds. In the presence of MgO the same bonds are formed, but without the formation of the HMDA-hydrofluoride. Heating the mixture of the copolymer and HMDA-HF results in the dehydrofluorination of the latter compound, making additional HMDA available for bond formation. The separated HF, however, tends to disrupt the C=N bonds. The susceptibility of these bonds may be the primary cause of the relatively low heat and acid resistance of fluoro-copolymers vulcanized with polyamines. TAB

N66-20179# Army Foreign Science and Technology Center, Washington, D. C.

FORUM OF RESEARCH AND TECHNICAL CHEMISTS

Dec. 1965 9 p Transl. into ENGLISH from Priroda (Moscow), no. 8, Aug. 1965 p 71-74 (FSTC-381-T65-816; AD-626792) CFSTI: HC $1.00/MF $0.50

Recent advances and achievements in agricultural chemistry and biochemistry were presented. Special attention was given to fertilizers, increased food production, and synthetic foodstuffs. Also reviewed were nutrient assimilation; molecular biology; trace elements; pharmaceutical chemistry and technology; production of tea, wine, and tobacco; and the chemical analysis of vegetables, fruit, and liquid food products. N.E.N.

N66-20221# Czechoslovak Academy of Sciences, Prague.

ISOMERIC EFFECTS IN RaE β-DECAY IN BISMUTH o-TOLYL, m-TOLYL, AND p-TOLYL DERIVATIVES [ISOMERNYE EFFEKTY PRI β-RASPADE RAE V SOSTAVE O-, M-, π-TOLIL'PROIZVODNYKH VISMUTA]

V. D. Nefedov, M. Vobetski, E. N. Sinotova, and I. Vorak Jan. 1965 5 p refs In RUSSIAN (UJV-1167/64)

Tracer bismuth (RaE) was produced by the neutron irradiation of Bi metal in a reactor. The Bi metal was dissolved in HNO_3 and treated with excess HCl to give $BiCl_3$ which was used in the synthesis of the ortho, meta, and para derivatives of bismuth. The organic compounds were purified by distilling with steam followed by recrystallization from a mixture of benzene and ethyl alcohol. The decay products were allowed to accumulate in the organic compound at room temperature and were analyzed by thin layer chromatography on Al_2O_3. The yield of Ar_3PoX compound was 67% for the ortho and para derivatives (o, p-$C_7H_7)_3Bi$, and 39% for the meta derivative (m-$C_7H_7)_3Bi$. The yield of Ar_2Po compound was 33% for the ortho and para derivatives (o, p-$C_7H_7)_3Bi$, and 61% for the meta derivative (m-$C_7H_7)_3Bi$. The rules established for organic chemical reactions are also valid for the behavior of molecular ions formed during the decay of a radioactive organometallic compound. NSA

N66-20228# Ceskoslovenska Akademie VED, Rez. Ustav Jaderneho Vyzkumu.
INVESTIGATION OF CHROMATOGRAPHIC BEHAVIOR OF CERTAIN ORGANIC TELLURIUM COMPOUNDS IN THIN ALUMINUM OXIDE LAYERS [ISSLEDOVANIYA KHROMATOGRAFISHESKOGO POVEDENIYA NEKOTORYKH TELLURORGANICHESCIKH SOEDINENII V TONCICH SLOYAKH OKISI ALYUMINIYA]
V. Vobetski, V. D. Nefedov, and E. N. Sinotova [1964] 9 p refs In RUSSIAN
(UJV-1168/64)

Unsupported Al_2O_3 layers 0.4 mm thick inclined at an angle of 15° were used to separate various organic tellurium compounds. With petroleum ether as a developing agent, the R_F values (given in parentheses) were determined with an accuracy of ±0.02 to 0.03 for the following diaryl derivatives of tellurium: $(o\text{-}CH_3C_6H_4)_2Te$ (0.61), $(m\text{-}CH_3C_6H_4)_2Te$ (0.54), $(p\text{-}CH_3C_6H_4)_2Te$ (0.54), $(p\text{-}(CH_3)_2C_6H_3)_2Te$ (0.62), $(p\text{-}CH_3O.C_6H_4)_2Te$ (0.54), $(\alpha\text{-}C_{10}H_7)_2Te$ (0.33), $(C_6H_5)_2O$ (0.59), $(C_6H_5)_2S$ (0.60), $(C_6H_5)_2Se$ (0.58), and $(C_6H_5)_2Te$ (0.56). Compounds showing a difference in R_F values can be readily separated from each other. It was also found that compounds of the type Ar_2TeCl_2 can be readily separated from compounds of the type Ar_3TeCl with the use of mixtures of benzene–ethanol or of ethyl-acetate–methanol as developing agents. NSA

N66-20249# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Chemistry.
CHEMICAL REACTIONS OF ATOMIC BEAMS AND RELATED PROBLEMS Final Report
N. C. Peterson and R. A. Marcus 3 Oct. 1965 5 p refs
(Contract AT(30-1)-2403)
(NYO-2403-8) CFSTI: HC $1.00/MF $0.50

Modifications were made to the atomic beam apparatus to improve the operating characteristics and to permit operation using argon as well as helium beams. An electron bombardment ionizer was added, together with a beam chopper. This system is designed to permit measurement of inelastic scattering of neutral particles by measurement of the ion current. Experiments to measure the cross sections for scattering helium ions from helium gas were carried out. The results were affected by charging of surfaces in the vacuum system. The measurements will be repeated using a modified vacuum pumping system. Author (NSA)

N66-20262# MSA Research Corp., Callery, Pa.
DEVELOPMENT OF TECHNIQUES FOR MEASUREMENT OF IMPURITIES IN SODIUM Quarterly Progress Report, Apr.–Jun. 1965
R. C. Andrews and K. R. Barker 30 Jul. 1965 46 p refs
(Contract AT(11-1)-765)
(MSAR-65-95) CFSTI: HC $2.00/MF $0.50

Laboratory and instream techniques are in the testing stage. Apparatus were obtained or built, and test data are being collected and evaluated. The initial data verify that the parameters being studied are related to some degree to the Na impurities of interest. Further testing and evaluations will be required to assert to what degree the methods under study are practical. Surface tension measurements of clean and contaminated K were made. K was used initially because the surface tension apparatus had been previously filled with this metal. The results showed a measurable increase in surface tension between pure K and O_2 contaminated K. The tests will be repeated using Na. Encapsulated samples of clean Na, air-contaminated Na, and C-contaminated Na were affected to different degrees in magnetic fields. The magnetic properties of Na impurities were shown to be diamagnetic in nature for both C and Na. Results of one completed run on pure Na indicated an analysis of 80 ppm O_2. The initial run is believed to be reasonable since contamination of the sample after charging was observed. Modifications in both apparatus and procedure are being made. Further evaluation of this procedure is planned. NSA

N66-20260# Atomics International, Canoga Park, Calif.
KINETICS OF THE REACTION OF URANIUM MONOCARBIDE WITH WATER
L. J. Colby, Jr. 25 Jul. 1965 16 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11401) CFSTI: HC $1.00/MF $0.50

The rate of hydrolysis of uranium carbide from 30 to 86.2°C was measured by a constant volume technique. An activation energy of 17.6 kcal/mole of UC was obtained from an Arrhenius plot of the data. The hydrolysis reaction rate at 70°C was found to be proportional to the square root of the water concentration when 2-propanol was used as a diluent. It is, therefore, postulated that the rate-determining step in the hydrolysis of uranium carbide involves the breaking of an O–H bond. Author (NSA)

N66-20274# Institute of Public Health, Tokyo (Japan). Dept. of Radiological Health.
REVIEW ON THE ANALYTICAL METHODS FOR THE STABLE AND RADIOACTIVE CAESIUM
Noboru Yamagata Mar. 1965 72 p refs
(Contract IAEA-140/R2/RB)
(NP-15366)

Analytical methods for determination of cesium are reviewed. Emphasis is placed on radiochemical separation methods and on analytical methods for trace amounts of stable cesium. Sample preparation and treatment are described. Separation methods based on precipitation, ion exchange, solvent extraction, paper chromatography and electrophoresis, and use of non-isotopic carrier in the carrier-free separation of cesium are discussed. Gravimetric, radioactivation, spectrographic, flame-photometric, and other methods of analysis are considered. NSA

N66-20275# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
SOME NEW DERIVATIVES OF THE $[Mo_6Cl_8]^{4+}$ ION
F. R. Cotton and N. F. Curtis 30 Oct. 1964 21 p refs
(Contract AT(30-1)-1965)
(MIT-1965-15) CFSTI: HC $1.00/MF $0.50

Attempts to prepare new compounds in which the six centrifugally directed Mo orbitals of $[Mo_6Cl_8]^{4+}$ are occupied by various ligands are described. Only in relatively few cases were stoichiometrically well-defined products obtained. These products were: $[Mo_6Cl_8L_8](ClO_4)_4$, $[Mo_6Cl_8L_2(CH_3SO_3)_4]$, and $[Mo_6Cl_{12}L_2]$, where L, in each type of compound, is either $(CH_3)_2SO$ or $HCON(CH_3)_2$. The infrared spectra of these compounds were studied and the assignments show that the ClO_4^- ions do not become coordinated while all $(CH_3)_2SO$ and $HCON(CH_3)_2$ molecules and the $CH_3SO_3^-$ ions are coordinated to Mo atoms through their oxygen atoms. From the composition and infrared evidence regarding coordination, it appears that in all cases the Mo_6Cl_8 group binds just six additional ligands. Author (NSA)

N66-20279# California Univ., Livermore. Lawrence Radiation Lab.

PREPARATION AND STUDY OF A SERIES OF BORANE AND OCTAHYDROTRIBORATE DERIVATIVES OF METHYLATED POLYAMINES

F. E. Walker and R. K. Pearson 2 Jul. 1964 11 p refs
(Contract W-7405-ENG-48)
(UCRL-7948) CFSTI: HC $1.00/MF $0.50

A series of borane and octahydrotriborate derivatives of methylated polyamines were prepared to determine the variance in certain chemical and physical properties with increasing chain length of the basic amines and with an increase in the number of carbon atoms between adjacent nitrogen atoms. Author (NSA)

N66-20290# California Univ., Berkeley. Lawrence Radiation Lab.

THE SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF TANTALUM

John H. Hill 28 Aug. 1964 9 p refs
(Contract W-7405-ENG-48)
(UCRL-7967) CFSTI: HC $1.00/MF $0.50

A spectrophotometric method was developed for the determination of 2 to 50 μg of tantalum. The tantalum is separated from most interfering elements by extracting with methyl isobutyl ketone from HCl–HF solution. It is then back-extracted into buffered ethylenedinitrilo-tetraacetate solution and $AlCl_3$ is added to complex excess fluoride ions. 2,6,7-Trihydroxy-9-phenylisoxanthene-3-one (phenylfluorone) is used to form the colored complex with tantalum. The coefficient of variation of the method ranges from 27% for the determination of 50 μg of tantalum to 7.2% for 2.5 μg. The interference of 33 foreign ions was investigated. Only Mo(VI), Nb(V), and Sn(II) interfered with the determination of 10 μg of tantalum. Up to 100 μg of Mo(VI) or Sn(II), or 50 μg of Nb(V) can be tolerated. Author (NSA)

N66-20298# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

INVESTIGATION OF COMPLEXES OF AMERICIUM AND PROMETHIUM USING SOLVENTEXTRACTION [IGUCHENIE KOMPLEKSOOBRAZOVANIYA AMERITSIYA I PROMETIYA EKSTRAKTSIONNYM METODOM]

I. Stary 12 Feb. 1965 10 p refs In RUSSIAN
(JINR-P-2000)

The extraction constant of americium (log C = −7.48) and promethium (log K = −7.82) with thenoyltrifluoracetone (solvent-benzene) was determined. Further the composition and stability constants of complexes of americium and promethium with tartaric acid (log β_1 = 3.9; log β_2 = 6.8), oxalic acid (log β_2 = 8.3; log β_3 = 11.8), nitrilotriacetic acid (log β_2 = 19.71 for Am; log β_2 = 19.74 for Pm), ethylenediaminetetraacetic acid (log β_1 = 16.91 for Am and log β_1 = 16.94 for Pm) and 1,2-diaminecyclohexanetetraacetic acid (log β_1 = 18.21 for Am and log β_1 = 18.17 for Pm) were determined. From the results it was found that the stability constants of americium are closer to promethium than to europium. Author (NSA)

N66-20308# Oak Ridge National Lab., Tenn.

THE CHEMISTRY AND THERMODYNAMICS OF MOLTEN SALT REACTOR FLUORIDE SOLUTIONS

C. F. Baes, Jr. [1965] 34 p refs Presented at the IAEA Symp. on Thermodyn., Vienna
(Contract W-7405-ENG-26)
(ORNL-P-1428; CONF-650704-6) CFSTI: HC $2.00/MF $0.50

As a result of the chemical development work done for the Molten Salt Reactor Experiment, considerable chemical and thermodynamic information has been acquired on LiF–BeF_2 and its solutions with actinide, lanthanide, and structural metal fluorides. A review is presented of this information. The data were obtained mainly by measurements of heterogeneous equilibria. The results of these measurements give direct information about such important chemical problems as: (1) the corrodibility of structural metals and the reducibility of the structural metal ions, Ni^{2+}, Fe^{2+}, Cr^{2+}; (2) reactions with water vapor to form oxide and hydroxide ions, and the removal of these ions; (3) the precipitation and solubility of the oxides of beryllium, uranium, zirconium, thorium, and the rare earths; (4) the stability of uranium (IV) toward reduction to the trivalent state and possible subsequent disproportionation; and (5) the solubilities and solid solution formation of rare earth fluorides. Equally important has been the wider usefulness of this information when the methods of thermodynamics are brought to bear. Thus the data obtained could be used to: (1) correlate, revise, and extend existing thermochemical data on fluorides and oxides; (2) determine activity coefficients of the components LiF, BeF_2, UF_4, and NiF_2 in these molten salt solutions; (3) calculate electrode potentials involving a variety of solute ions; and (4) estimate solubilities and reactivities of compounds not directly investigated. NSA

N66-20309# Ceskoslovenska Akademie VED, Rez. Ustav Jaderneho Vyzkumu.

CHEMICAL STUDY OF THE β DECAY OF ^{210}Bi IN TRIARYLBISMUTH DIHALOGENS [CHEMISCHE FOLGEN DES β-ZERFALLS VON ^{210}Bi IN TRIARYLWISMUTDIHALOGENIDEN]

V. D. Nefedov, M. Vobecky, and J. Borak Jan. 1965 6 p refs in GERMAN
(UJV-1169/64)

It was attempted to determine the effect of the halogen in the molecule on the yield of the Ar_3PoX and Ar_2PoX_2-type compounds which are formed during the β decay of ^{210}Bi in crystalline compounds of Ar_3BiX_2, whereby X designates F, Cl, or Br and Ar represents o-, m-, p-tolyl or p-xylyl. The starting materials were prepared by Grignard synthesis from anhydrous $BiCl_3$; the ^{210}Bi was obtained by irradiating high-purity metallic Bi to a flux of 10^{13} n/cm^2 sec for 5 days. The decay products were collected in the mother compound at room temperature and were analyzed by chromatography on Al_2O_3 with and without nonisotopic carrier. The products were identified by comparing them with Po compounds; the quantitative determinations involved measurement of the α emission of ^{210}Po. It was found that the yield depends markedly on the halogen incorporated in the molecule: when changing from the difluoride to the analogous dibromide derivative, the Ar_3PoX increased strongly, being accompanied by a corresponding decrease of the Ar_2PoX_2 yield. The thermodynamically unstable $[Ar_3PoX_2]^+$ molecular ions are also a product of the β decay; their subsequent decomposition also depends on the halogen used. NSA

N66-20310# Atomics International, Canoga Park, Calif.

GLAD (GAUSSIAN AND LORENTZIAN, ABSORPTION AND DERIVATIVE CURVES)

Katherine W. Medeiros and W. A. Young Mar. 1964 60 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-9823) CFSTI: HC $3.00/MF $0.75

A code which calculates analytically and plots, in optional combinations, graphs of Gaussian and Lorentzian absorption and derivative curves is described. Author (NSA)

N66-20315# Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.

INVESTIGATION OF CATALYTIC RECOMBINATION OF RADIOLYTIC OXYGEN AND HYDROGEN Quarterly Report No. 5, Oct.-Dec. 1964

C. Thomas Sawyer and F. M. Stern 10 Jan. 1965 19 p ref
(Contract AT(40-1)-3151)
(CEND-525; EURAEC-1330) CFSTI: HC $1.00/MF $0.50

The endurance testing of catalysts is accomplished by taking 835–900 psig power plant steam, superheating it to the desired temperature, adding metered hydrogen and oxygen, passing the steam over the catalysts and monitoring the effluent for the remaining free oxygen. For parallel arrangement tests, 60 lb/hr of steam was passed through each of the catalysts. Several conditions existed in the catalyst beds during the tests. Data are tabulated. Because the use of the catalytic recombiner was successful in inhibiting chloride stress corrosion, tests were made on the effects of oxygen on intergranular corrosion. For these tests, stressed and sensitized Type 304 stainless steel specimens were exposed to 800°F, 860 psig steam. Two weeks of testing produced no intergranular cracks or attack in specimens located either upstream or downstream of the catalyst bed. Fourteen days of operation at 800°F, 835 psig, and 775 lb/hr without any injected chlorides also produced no intergranular cracks or attack. NSA

N66-20339# Iowa State Univ. of Science and Technology, Ames.

AN ELECTRON DIFFRACTION INVESTIGATION OF PHOSPHORUS PENTAFLUORIDE AND METHYLTETRAFLUOROPHOSPHORANE

Kathryn Wirth Hansen (M.S. Thesis) Feb. 1965 51 p refs
(Contract W-7405-ENG-82)
(IS-T-4) CFSTI: HC $2.00/MF $0.50

An electron diffraction study was made on PF_5 and PF_4CH_3, including a review of the theories concerning their stereochemistry. A correlation of theoretical and experimental structures was made. The results showed that the experimentally determined structures for PF_5 and PF_4CH_3 agree with the theoretical formulations given. It was noted that the equatorial and axial distances are both longer in PF_4CH_3 than in PF_5. The equatorials are 0.009 Å longer and the axials 0.035 Å. This may be caused in part by the repulsions of the methyl group. Since the axial fluorines are closer to the methyl group than are the equatorial, it is expected that the axial distances would show the greater difference. The P-C distance is also shorter in PF_4CH_3. This is presumably due to the highly electronegative fluorine atoms connected to the phosphorus. NSA

N66-20348# Oak Ridge National Lab., Tenn.

RADIOACTIVATION ANALYSIS AS AN ANALYTICAL TOOL

W. S. Lyon 1965 25 p refs Presented at Conf. on Purification of Mater., New York
(Contract W-7405-ENG-26)
(ORNL-P-1237; CONF-650521-1) CFSTI: HC $1.00/MF $0.50

A survey is presented of the characteristics of activation analysis. Possible interferences and errors are discussed, taking the determination of cobalt as an example. Nondestructive activation analysis using gamma-ray spectrometry is next considered. The decay schemes and gamma spectra of ^{60}Co and ^{60m}Co are described, and the application of computer techniques to data handling is discussed. Finally, non-reactor neutron sources and non-neutron activation analysis are considered. NSA

N66-20351# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

DISSOLUTION EXPERIMENTS OF ALUMINUM AND S.A.P. CLADDING MATERIAL IN A LABORATORY RECIRCULATION DISSOLVER [DISSOLUZIONE DEI RIVESTIMENTI IN ALLUMINIO ED IN S.A.P. DI ELEMENTI DI COMBUSTIBILE IN UN DISSOLUTORE A RICIRCOLAZIONE]

G. Beone Jan. 1965 43 p refs In ITALIAN
(RT/CHI(65)-1)

Experiments on the sulfuric acid dissolution of aluminum tubes catalyzed by mercuric sulfate, and on the caustic attack of S.A.P. are reported. A glass recirculation dissolver was used, and the dissolution rates were evaluated under different experimental conditions. The dissolution times and the composition of the resulting solutions are quite acceptable on the bases of applicability to an industrial process. Settling rates of suspended alumina in the caustic dissolution of S.A.P. are favorable. A tentative head end flowsheet for decladding S.A.P. or aluminum-clad fuels is outlined.
Author (NSA)

N66-20357# Oak Ridge National Lab., Tenn.

STUDIES OF THE BEHAVIOR OF PROTACTINIUM IN SULFURIC ACID

D. O. Campbell 8 Jan. 1965 13 p refs
(Contract W-7405-ENG-26)
(ORNL-P-971) CFSTI: HC $1.00/MF $0.50

Studies of the chemistry of protactinium in sulfuric acid solutions were continued, utilizing primarily the solvent extraction method. Emphasis has been placed on the behavior at relatively high protactinium concentrations, up to several mg/ml. Data is reported for extractions into 0.03M trilaurylamine from 2.5, 3.2, and 4.17M sulfuric acid. In all cases a reasonably constant extraction coefficient is observed if the protactinium concentration in the aqueous phase is below about 0.004 mg/ml, but at higher concentrations extraction increases sharply. Above 0.01 mg/ml consistent extraction coefficients are observed for the higher acid concentrations, but for 2.5M acid results are not reproducible. Rates of extraction are very slow for the higher protactinium concentrations. The change in extraction behavior with protactinium concentration is interpreted in terms of the existence of several species which are probably polymeric in protactinium. At least two of these are extractable, but the species formed at higher protactinium concentrations are inextractable although they reach equilibrium with the extractable species very slowly. Author (NSA)

N66-20366# Connecticut Univ., Storrs.

DISTRIBUTION STUDIES BETWEEN MELTS AND SOLID PHASES USING RADIOACTIVE TRACERS Final Report

W. C. Orr and Peter Vilinskas 30 Jan. 1965 105 p refs
(Contract AT(30-1)-1154)
(NYO-1154-1) CFSTI: HC $4.00/MF $0.75

The self-diffusion coefficient of sodium ions in soldalite ($Na_8Al_6Si_6O_{24}Cl_2$) was determined as a function of temperature between 307 and 720°C using sodium-22 as a tracer. The procedure consisted in observing the exchange of sodium between a molten salt containing the tracer and solid multicrystalline sodalite. The electrical conductivity of the natural mineral has been determined as a function of temperature. By assuming that the sodium ions are the only charge carriers, the ion mobility was estimated from the conductivity. From the mobility information obtained by the two different methods, conclusions could be drawn concerning the type of disorder present among the sodium ions and the mechanism

of transport. In evaluating the results of the exchange experiments, the usual approximation of uniform spheres was discarded in favor of a distribution of spheres of various sizes. The solution of Fick's equation under these conditions is given, as well as the computer program used in its evaluation. Author (NSA)

N66-20369# Fordham Univ., New York.
THE STUDY OF URANYL NITRATE-UREA COMPLEXES PREPARED BY SOLID-SOLID INTERACTION AND FROM SOLUTION
Louis S. Campisi (Ph.D. Thesis) 1965 90 p refs
(Contract AT(30-1)-906)
(TID-21610) CFSTI: HC $3.00/MF $0.75

Utilizing a solid-solid interaction, $[UO_2(NO_3)(Urea)_3](NO_3)$, $[UO_2(Urea)_5](NO_3)_2$, and α- and β-$[UO_2(NO_3)_3(Urea)_2]$ were prepared for the first time. These compounds were also isolated from solution, in addition to $[UO_2(Urea)_4(NO_3)(H_2O)]NO_3$, $UO_2(NO_3)_2 \cdot 4Urea \cdot 2H_2O$, and $UO_2(NO_3)_2 \cdot 2C_2H_5OH$. The absence of an anhydrous tetrakis(urea) uranyl nitrate complex has been noted, dehydration of $[UO_2(NO_3)(Urea)_4(H_2O)](NO_3)$ leading to a mixture of $[UO_2(NO_3)(Urea)_3](NO_3)$ and $[UO_2(Urea)_5](NO_3)_2$. The deleterious influence of KBr on the infrared spectra of uranyl nitrato complexes is reported. Infrared studies on all of the complexes indicate that the ligand, urea, is bound through the carbonyl oxygen to the uranyl ion. For the series of complexes prepared, infrared data were interpreted with regard to nitrate and nitrato groups. It was found that nitrato coordination decreases as the number of other ligands (urea) increases. An explanation for the formation and stability of $[UO_2(NO_3)_2(Urea)_2]$ in ethanol and the tetrakis(urea) complex in water, has been offered. Author (NSA)

N66-20370# Temple Univ., Philadelphia, Pa.
[FUSED SALT SYSTEMS] Technical Progress Report, Jan.–Dec. 1964
Jan. 1965 33 p refs
(Contract AT(30-1)-2780)
(TID-21615) CFSTI: HC $2.00/MF $0.50

A characterization was made of the dark blue precipitate which forms in cobalt solutions in $LiNO_3$–KNO_3 eutectic below 180°C when KCl is added. Chemical analyses, spectra, magnetic measurements and X-ray diffraction show that the precipitate is a compound $K_4CoCl_4(NO_3)_2$ and that cobalt in this compound is eight coordinated. A study was made of the experimental parameters involved in the abnormal conductivity results obtained when large and small vessels are used. It is concluded that, for KCl in $LiNO_3$–KNO_3 eutectic, noticeable wall conduction can occur using a large pyrex glass vessel and a single capillary electrode. NSA

N66-20371# Brookhaven National Lab., Upton, N. Y.
Co^{60} GAMMA RADIATION INDUCED POLYMERIZATION OF ETHYLENE AT CONSTANT CONDITIONS IN A NON-FLOW SYSTEM
L. E. Kukacka, P. Colombo, J. Fontana, R. N. Chapman, and M. Steinberg Jan. 1965 39 p refs
(Contract AT(30-2)-GEN-16)
(BNL-8801) CFSTI: HC $2.00/MF $0.50

The yield and rate of polymerization of gaseous ethylene in a ^{60}Co gamma field were determined in a 100 cc static system under constant conditions of pressure, initial temperature, and radiation intensity. The experimental conditions ranged in pressure from 170 to 1920 atm, in temperature from 20 to 200°C, and radiation intensity from 5.8×10^4 to 8.5×10^5 rads/hr. A negligibly small activation energy of 0.2 kcal/mole was determined for solid polymer formation in the temperature range 20 to 100°C and 14.5 kcal/mole for molten polymer formation in the range from 120 to 200°C. Empirical relationships for the rate of polymerization and yield for the pressure range 170 to 1360 atm and at radiation intensities between 5.8×10^4 and 8.5×10^5 rads/hr were determined. The 0.5 power dependence of the intensity on rate indicates a free radical mechanism. The 2.7 power pressure dependency is much greater than ideally expected, indicating possible steric effects. At a radiation intensity of 1.79×10^5 rads/hr, pressures above 970 atm, and temperatures above 130°C, differential rates greater than 0.3 g/liter-hr-atm, corresponding to G values greater than 1.0×10^5 molecules/100 ev, were obtained. Polymerizations leading to exposive decomposition were noted at pressures above 850 atm. NSA

N66-20392# Oak Ridge National Lab., Tenn.
UNEXPECTED RATE EFFECTS IN THE EXTRACTION OF RARE EARTHS BY DI(2-ETHYLHEXYL)PHOSPHORIC ACID
D. J. Crouse and D. E. Horner [1965] 16 p refs Presented at the Intern. Conf. on the Chem. of the Solvent Extraction of Metals, Harwell, England, 27–29 Sep. 1965
(Contract W-7405-ENG-26)
(ORNL-P-1603; CONF-650918-7) CFSTI: HC $1.00/MF $0.50

In extraction of fission product rare earths with di(2-ethylhexyl) phosphoric acid from tartrate- (or citrate-) complexed waste liquors (pH 5), the rates of extraction are decreased by the presence of certain metal ion contaminants, such as iron, aluminum, and particularly chromium. Apparently, these metal ions react with the rare earths ions and tartrate in the aqueous phase to form non-extractable complexes that are slow to dissociate. The magnitude of the effect is different with each interfering metal ion and also for the different rare earths. Increasing the tartrate concentration increases the rates of extraction. Author (NSA)

N66-20411# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
COMPETITION KINETIC EQUATIONS FOR RADIOLYTIC DECARBOXYLATION OF AQUEOUS BENZOATE SOLUTIONS
R. W. Matthews and D. F. Sangster Mar. 1965 7 p refs
(AAEC/TM-282)

The decarboxylation of benzoate during the irradiation of a dilute aerated aqueous solution by ionizing radiation involves additional post-irradiation production of carbon dioxide during the period immediately following the removal of the solution from the radiation field. Various possible reactions are considered and equations derived for the relationship between product yield, yield of the attacking species, reaction rate constants, and the relative concentration of two solutes competing for a common attacking species. The system can be used to measure relative rate constants. Author

N66-20421# Institutt for Atomenergi, Kjeller (Norway).
DETERMINATION OF TRACE ELEMENTS IN ZONE-REFINED ALUMINIUM BY NON-DESTRUCTIVE ACTIVATION ANALYSIS
E. Steinnes Feb. 1965 12 p refs

Neutron activation and γ-spectrometry were used for the determination of trace elements in "super pure" aluminum before and after zone refinement of the metal. The following

elements were determined quantitatively: Cr, Cu, Dy, La, Mn, Nd, Sc, and Sm. Upper limits of contents were established for Co, Fe, Ga, Hg, In, and Zn. It is concluded that non-destructive activation analysis can be a useful aid in studies of zone-refined metals. Author

N66-20425# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
THE DETERMINATION OF TRACE AMOUNTS OF TANTALUM AND TUNGSTEN IN METALS
A. F. Voigt, G. L. Jewett, E. C. Jacobson, K. L. Malaby, and J. D. Woods 1 Mar. 1965 17 p refs Presented at Intern. Conf. on Mod. Trends in Activation Analysis, College Station, Tex. 19–22 Apr. 1965
(Contract W-7405-ENG-82)
(IS-1117; CONF-650405-2) CFSTI: HC $1.00/MF $0.50

Neutron activation analysis was applied to the determination of tantalum and tungsten in thorium and of tantalum in yttrium with success. Two procedures were developed for the determination of tantalum in thorium using ^{182}Ta, one using chemical techniques and the other a simple method of absorbing interfering radiation. The chemical method was designed particularly to remove ^{233}Pa. The determination of tantalum in yttrium metal is done by a chemical method involving the addition of a solution of tantalum carrier in HNO_3 HCl, and HF to the yttrium sample in HCl. This step precipitates YF_3 and traces of yttrium are removed with a Dowex-50 column. Tantalum is precipitated and counted as the hydrated oxide. A method was developed for determining tungsten in thorium which uses the insolubility of tungstic oxide in acidic solutions and its solubility in base to separate it from Th and Pa which precipitate or are absorbed on an anion exchange column from a basic solution. NSA

N66-20433# Institutt for Atomenergi, Kjeller (Norway).
DETERMINATION OF TRACE ELEMENTS IN PHARMACEUTICALS BY NEUTRON ACTIVATION ANALYSIS
O. Johansen, G. Lunde (Central Inst. for Ind. Res.), and E. Steinnes Feb. 1965 14 p refs
(KR-91)

Neutron activation and gamma spectrometer were used for determination of Cu, Mn, Hg, Zn, Cr, Sb, Co, and Sc in samples of barbiturates, adrenalin, starch, and ascorbic acid. The work indicates that activation analysis is a suitable method for determination of trace elements in drugs. Author (NSA)

N66-20435# California Univ., Berkeley. Lawrence Radiation Lab.
DECAY OF THE Zn^{64*} COMPOUND NUCLEUS FORMED BY NUCLEAR REACTIONS OF p, He^3, He^4, AND C^{12} WITH Cu^{63}, Ni^{61}, Ni^{60}, AND Cr^{52}, RESPECTIVELY
Charles F. Smith, Jr. (h.D. Thesis) Jan. 1965 118 p refs
(Contract W-7405-ENG-48)
(UCRL-11862) CFSTI: HC $4.00/MF $0.75

An experimental, radiochemical determination of the excitation functions for reactions involving the $^{64*}Zn$ compound nucleus was performed. The reactant pairs are: $p+^{63}Cu$, $^3He+^{61}Ni$, $^4He+^{60}Ni$, and $^{12}C+^{52}Cr$ while the observed products for each such pair are: ^{63}Zn, ^{62}Zn, and ^{62}Cu. Total reaction cross sections are calculated from the optical model. The ratio of the cross section for a given reaction to the total reaction cross section are compared on an excitation energy abscissa for each product. The shape and magnitude of these ratio curves is essentially constant in each such comparison, suggesting a compound nuclear reaction mechanism. Range measurements for ^{62}Zn recoils are made and compared to calculated ranges based on the theory of Lindhard, Scharff, and Schiøtt for a compound nuclear reaction. Good agreement is found. The shapes of these curves are compared to a theoretical estimate obtained from evaporation theory, and are shown to be similar to the calculated shapes. A displacement of the experimental curves relative to one another along the excitation energy axis is noted, and ascribed to angular momentum effects. Using the position of the ^{64}Zn photoexcitation curves of Sagane as reference points, and spin averaged angular momenta of the compound system, the reduced moment of inertia is calculated for the four systems. At least two distinct values are found, indicating a difference between orbital- and spin-angular momenta, the latter causing the greater energy shift in the excitation functions. This observation is shown to be of value in understanding similar energy discrepancies in excitation function comparisons. Because of the observed relation between the mode of formation and the mode of decay of the compound nucleus, it is concluded that the independence postulate is not strictly applicable to this system as a whole. Author (NSA)

N66-20440# ACF Industries, Inc., Albuquerque, N. Mex.
AN ANALYTICAL CHEMISTRY EVALUATION—MACHINE HANDLING OF ANALYTICAL DATA
J. D. Allen 12 Mar. 1965 37 p refs
(Contract AT(29-0-1325)
(ACF-5; ACF-413-233) CFSTI: HC $2.00/MF $0.50

Developments in instrumentation have resulted in the rapid generation of volumes of data which must be assimilated and interpreted. A literature survey was conducted to determine the areas of analytical chemistry methodology in which computer handling of such data could be applied. X-ray emission spectroscopy, X-ray diffraction, electron probe analysis, mass spectrometry, neutron activation analysis, absorption spectroscopy, and gas chromatography were covered. It is pointed out that similar techniques and programs could be used in several of these areas. NSA

N66-20461# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
PURIFICATION OF MATERIALS. OPTICAL EMISSION SPECTROSCOPY AS AN ANALYTICAL TOOL
Edward L. De Kalb, Richard N. Kniseley, Velmer A. Fassel 23 Aug. 1965 52 p refs Presented at the Conf. on Purif. of Mater, New York, 6-8 May 1965; Sponsored by N. Y. Acad. of Sci.
(Contract W-7405-ENG-42)
(CONF-650521-2; IS-1237) CFSTI: HC $3.00/MF $0.50

The characteristic line spectra emitted by the elements in flames and discharges can be used for the detection and determination of trace impurities. A review is presented of special problems encountered in applying these spectra to the quantitative determination of trace impurities at lower and lower concentration levels. Detection limits, excitation by arc and spark, carrier distillation, controlled atmospheres, liquid samples, enrichment, and analysis of residues are considered. NSA

N66-20469# Los Alamos Scientific Lab., New Mexico.
EVALUATION OF HIGH EXPLOSIVE BY PYROLYSIS
John F. Baytos May 1965 22 p refs
(Contract W-7405-ENG-36)
(LA-3249) CFSTI: HC $2.00/MF $0.50

The thermal stability and compatibility of explosives and new explosive mixtures can be measured by detecting the evolved gases as an explosive is heated to decomposition. This technique is known as pyrolysis gas evolution analysis (PGEA). An apparatus was built that would enable one to perform these PGEA experiments on a routine basis as a complement to the other stability and compatibility tests. The apparatus is based on the prototype developed by R. N. Rogers and is described in detail. The various operating sequences are arranged for safety and ease of performance so that an operator's attention is given to gathering experimental data rather than to instrumentation. A detailed experimental procedure is given, and some preliminary experiments made to check the performance of this apparatus are described. Calibration procedures are also included. Preventive and corrective maintenance procedures are given. Illustrations and typical curves are also included. Author (NSA)

N66-20485# Los Alamos Scientific Lab., N. Mex.
FLUORIDE COMPLEXES OF TETRAVALENT PROTACTINIUM
L. B. Asprey and R. A. Penneman [1965] 9 p refs Presented at Intern. Conf. on Protactinium Chem., Orsay, France, 2-8 Jul. 1965
(Contract W-7405-ENG-36)
(CONF-650701-4; LA-DC-6900) CFSTI: HC $1.00/MF $0.50

The compound $(NH_4)_4PaF_8$ was made from NH_4F and PaF_4. It is isostructural with $(NH_4)_4UF_8$, $(NH_4)_4NpF_8$, $(NH_4)_4PuF_8$, and $(NH_4)_4AmF_8$. Details of the syntheses of this and other alkali fluoride complexes are given along with structural data. Author (NSA)

N66-20495# United Kingdom Atomic Energy Authority, Springfields (England). Chemical and Metallurgical Services.
ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF URANIUM TRIFLUORIDE IN THE PRESENCE OF URANIUM TETRAFLUORIDE AND DIOXIDE
1965 7 p refs
(PG-625(S)) HMSO: 1s 9d

A weighed portion of the sample is dissolved in phosphoric acid containing ferric ion. The ferrous ion resulting from the reduction by U^{III} is titrated potentiometrically with a standard uranyl solution. The method is suitable for the determination of 2.5 to 135 mg U^{III}. The method has been employed for the determination of (a) 65–85% UF_3 in the presence of uranium tetrafluoride and dioxide as the balance, and (b) 0.5 to 6% UF_3 in mixtures of uranium tetrafluoride with alkali and alkaline earth fluorides. Uranium metal and/or U^{VI} interferes but may be corrected for if the concentrations are known. Three duplicate determinations on samples of uranium trifluoride determined at 67, 78, and 79% UF_3 agreed within 0.4, 0.3, 0.0% (abs.) respectively. Author (NSA)

N66-20497# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
A KINETIC STUDY OF THE REACTION OF WATER VAPOR AND CARBON DIOXIDE ON URANIUM [CINETIQUE DE LA REACTION DE LA VAPEUR D'EAU ET DU DIOXYDE DE CARBONE SUR L'URANIUM]
Jean-Paul Santon (Ph.D. Thesis—Grenoble Univ.) 1965 72 p refs In FRENCH
(CEA-R-2596)

The kinetic study of the reaction of water vapor and carbon dioxide with uranium was performed by thermogravimetric methods at temperatures between 160 and 410° C in the first case, 350 and 1050° C in the second. Three types of uranium specimens were used: uranium powder, thin evaporated films, and small spheres obtained from a plasma furnace. The experimental results led in the case of water vapor, to a linear rate of reaction controlled by diffusion at the lower temperatures, and by a surface reaction at the upper ones. In the case of carbon dioxide, a parabolic law was found, controlled by diffusional processes. Author (NSA)

N66-20501# Naval Radiological Defense Lab., San Francisco, Calif.
DEVELOPMENT OF A HIGH-TEMPERATURE ISOPIESTIC TECHNIQUE. EQUILIBRATION OF VAPOR FROM RUBIDIUM AND MOLYBDENUM OXIDES WITH VARIOUS NONVOLATILE OXIDES
C. E. Adams and J. T. Quan 18 Jan. 1965 41 p refs
(Contracts AT(49-7)-1963; AT(49-2)-1167)
(USNRDL-TR-823) CFSTI: HC $2.00/MF $0.50

A modification of the isopiestic method of determining chemical activities in solutions was developed for use with liquid metallic oxides at high temperatures. This method was tested by measuring the uptake of vaporized rubidium and molybdenum oxides by a number of simple oxides and binary oxide systems. The experimental results were used to investigate the interactions and the formation of structural groups among the components of liquid oxide solutions. Author (NSA)

N66-20502# Sloan-Kettering Inst. for Cancer Research, New York.
BIOLOGICAL EFFECTS OF RADIATION, AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES Summary Progress Report, Jul. 1950–15 Mar. 1965
Joan S. Laughlin et al 23 Jun. 1965 196 p refs
(Contract AT(30-1)-910
(NYO-910-23) CFSTI: HC $5.00/MF $1.00

Summaries of research done in the period July 1, 1950 to March 15, 1965, are presented, and bibliographies of publications resulting from research in the period are included. Separate abstracts were prepared for reports on biophysics, biological chemistry, and clinical investigations. NSA

N66-20510# Union Carbide Nuclear Co., Tuxedo, N. Y. Mining and Metals Div.
RADIOCHEMISTRY OF SELENIUM
V. J. Molinski and G. W. Leddicotte Washington, AEC, Nov. 1965 55 p refs Revised
(Contract W-7405-ENG-26)
(NAS-NS-3030(Rev)) CFSTI: HC $1.00/MF $0.50

A review is presented on nuclear and chemical properties of Se, methods of sample dissolution and of separation reactions, descriptions of counting techniques, and radiochemical separation procedures for Se. NSA

N66-20514# Brookhaven National Lab., Upton, N. Y. Chemistry Dept.
REFINEMENT IN METHODS OF NEUTRON ACTIVATION ANALYSIS OF ANCIENT GLASS OBJECTS THROUGH THE USE OF LITHIUM DRIFTED GERMANIUM DIODE COUNTERS
Edward V. Sayre [1965] 28 p refs Presented at 7th Intern. Glass Congr., Brussels
(Contract AT(30-2)-GEN-16)
(BNL-9614; CONF-650640-2) CFSTI: HC $2.00/MF $0.50

With new lithium drifted germanium diode solid state detectors, which record photopeaks with nearly ten times the resolution of large crystal scintillation detectors, it was possible to determine nondestructively the concentrations of some rare earth oxides in ancient glasses. Of these the concentration of europium oxide, although below spectrographically detectable limits, showed a pronounced and significant reverse correlation with the concentrations of magnesium and potassium oxides. It has been suggested that the alkali used in the preparation of ancient glasses which are characterized by low concentrations of magnesium or potassium oxides might have been natron, the naturally deposited sodium carbonate from the lakes of the Wadi Natroun in Egypt. If natron contained a sufficiently high concentration of europium oxide its use in these glasses would be indicated. However specimens of both ancient and modern natron were found not to contain the relatively high europium concentrations which characterize the low magnesium and potassium ancient glasses. NSA

N66-20518# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

STUDY OF THE LOW TEMPERATURE OXIDATION OF URANIUM POWDERS AND ITS APPLICATION TO THE SINTERING OF URANIUM OXIDE POWDERS [ETUDE DE L'OXYDATION DES POUDRES D'URANIUM A BASSE TEMPERATURE ET SON APPLICATION AU FRITTAGE DE POUDRES D'URANIUM OXYDE]

Madeleine Conte-Albert (Ph.D. Thesis—Paris Univ.) 1965 87 p refs In FRENCH
(CEA-R-2828)

The uranium oxygen reaction was studied with a view of obtaining U–UO_2 samples containing about 20% by weight of UO_2 starting from spherical grain uranium powder ($36\ \mu < \phi < 50\ \mu$) The techniques used were micrography, thermogravimetry, sintering under pressure, and radiocrystallography. At 170°C in air or argon+oxygen mixtures, the uranium oxide formed was always UO_2 and was uniformly distributed around the initial uranium spheres. These mixed powders can easily be sintered under pressure in the γ-phase. The density of the samples obtained was 85 to 90% of the theoretical density. The influence of UO_2 on the properties of uranium was found by the use of dilatometry and thermal cycling in the α phase. The temperatures at which the phase changes $\alpha \rightleftarrows \beta$ and $\beta \rightleftarrows \gamma$ occurred were lowered, the remanent expansion was decreased. High density samples resisted thermal cycling; the characteristic defects of uranium, high distortion and wrinkled surface, almost disappeared. Heat treatments in a secondary vacuum at 1050°C caused crystallization of UO_2 in a geometrical form and the appearance of a phase of the fcc crystalline type having the composition $U_WC_XO_YN_Z$. This phase caused a new decrease in the $\alpha \rightleftarrows \beta$, $\beta \rightleftarrows \gamma$ transformation temperatures for the uranium. After ten dilatometric cycles the remanent expansion of the sample was about 0.5%. The resistance to thermal cycling of a low density sample that was heat-treated was similar to that of a high density sample that had not undergone a heat treatment. Author (NSA)

N66-20540# California Univ., Berkeley. Lawrence Radiation Lab.

KINETICS OF VAPORIZATION OF ALUMINUM NITRIDE AND MAGNESIUM NITRIDE

Bette A. H. Blank (Ph.D. Thesis) 23 Apr. 1965 45 p refs
(Contract W-7405-ENG-48)
(UCRL-16018) CFSTI: HC $2.00/MF $0.50

The kinetics of vaporization of aluminum nitride and magnesium nitride to metal gas atoms and nitrogen gas was studied, both in vacuum and in gaseous atmospheres of argon and nitrogen. An equation for log K_{eq} and the equilibrium total pressure of AlN sublimation as a function of temperature was found to be: $\log K_{eq} = 3/2 \log P_T - 0.3150 = -[(145.516 \pm 9.429)/45.76](10^4/T) + 11.277 \pm 1.270$. The third-law and second-law enthalpies for the sublimation of aluminum nitride are 153.2 and 150.4 ±9.4 kcal/mole, respectively. The third-law and second-law enthalpies of activation ($\Delta H^{\ddagger}_{298}$) are 175.9 and 150.8 ±12.1 kcal/mole, respectively. The second-law entropy and entropy of activation are 58.44 and 44.96 cal/° K/mole AlN, respectively. The log K_{eq} and total pressure of the decomposition of Mg_3N_2 to Mg gas atoms and N_2 gas can be expressed as a function of temperature by the following equation: $\log K_{eq} = 4 \log P_T - 0.9780 = -[(245.979 \pm 16.64)/45.76](10^4/T) + 28.733 \pm 3.162$. The $\Delta H°_{298} = 242.3$ by the third-law method, and 239.1 ±16.5 kcal/mole by the second-law method. The $\Delta H^{\ddagger}_{298}$ (third law) = 286.3 kcal/mole, and 218.7 ±12.9 kcal/mole by the second-law method. The second-law $\Delta S°_{298}$ and $\Delta S^{\ddagger}_{298}$ are 121.56 and 66.35 eu, respectively. The heat of formation of Mg_3N_2 calculated from our approximate equilibrium data is −136.8 kcal/mole. Evaporation of Mg_3N_2 in atmospheres of argon and nitrogen of pressures, which are of the order of magnitude of the sublimation pressure or greater, decreases the rate of evaporation. Nitrogen reduces the evaporation rate by about an order of magnitude more than does argon at the same background pressures. Author (NSA)

N66-20542# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

INCREASED SENSITIVITY IN X-RAY FLUORESCENCE ANALYSIS USING FILTERED EXCITING RADIATION

K. P. Champion and R. N. Whittem Apr. 1965 11 p refs
(AAEC/TM-289)

The use of filters in the primary beam of an X-ray spectrometer is suggested as a method of increasing sensitivity of detection. A theoretical and experimental treatment of the case of strontium aqueous solution has been made. Results show a considerable improvement in detection limit in some circumstances, and a marginal improvement in others.
Author (NSA)

N66-20543# Oak Ridge National Lab., Tenn.

THERMODYNAMIC CALCULATION OF THE YIELD OF URANIUM NITRIDE DURING CARBOTHERMIC REDUCTION OF URANIUM OXIDE IN THE PRESENCE OF PURE NITROGEN OR NITROGEN MIXED WITH HYDROGEN OR INERT GAS

T. A. Gens 16 Sep. 1965 16 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1264) CFSTI: HC $1.00/MF $0.50

Calculations based on published free energy data indicate that the equilibrium yields of uranium nitride per mole of nitrogen introduced over heated uranium dioxide and carbon increase from 6×10^{-9} mole to 0.13 mole as the temperature increases from 1000 to 2000°K. The introduction of either hydrogen or inert gas causes the yield per mole of nitrogen to increase slightly. There is no significant difference between the effects of hydrogen and inert gas on yields. The results of these calculations are being used to guide the laboratory preparation of microspheres of UN. Author (NSA)

N66-20559# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

STUDY OF ZIRCONIUM AND NIOBIUM PURITIES DURING A CHEMICAL SEPARATION. MEASUREMENT OF THE ISOTOPES OF THE 95 CHAIN [ETUDE DE LA PURETE DU ZIRCONIUM ET DU NIOBIUM AU COURS D'UNE SEPARATION CHIMIQUE MESURE DES ISOTOPES DE LA CHAINE 95]

Pierre Simonet and Genevieve Simonet Mar. 1965 50 p refs In FRENCH

(CEA-R-2729)

This study is done by γ spectrometry; when ^{95}Zr is contaminated by ^{95}Nb or reciprocally, their measurement becomes difficult because of the weak difference between γ ray energies. Proportions of ^{95}Zr and ^{95}Nb may be obtained quickly, whatever the age of the mixture, by a graphical method. The stabilizer of drift improves security in accuracy of results. In case of separation of ^{95}Zr and ^{95}Nb from two different phases, partition coefficients may be determined by measuring the evolution of ^{95m}Nb formed using the 17 keV X-ray; comparison with a theoretical curve representing the formation of ^{95m}Nb permits a great accuracy. During this study, some nuclear constants which were insufficiently known were determined. Author (NSA)

N66-20565# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.

THE DETERMINATION OF LANTHANIDES IN URANIUM BY NEUTRON-ACTIVATION ANALYSIS

M. Vobecky, A. Mastalka, and J. Marecek Feb. 1965 15 p refs (UJV-1151/64)

The method of determining lanthanides in uranium using activation method of analysis is described. Having separated uranium on anion exchangers, the activation determination of the lanthanide oxides was then carried out. Final isolation of individual lanthanides was accomplished chromatographically on cation exchangers. After 20-hour irradiation in a nuclear reactor with a flux of 10^{13} neutrons cm^{-2} sec^{-1}, 4×10^{-12}% of Dy, 10^{-10}% of Eu, 4×10^{-9}% of Sm, and 1.5×10^{-8}% of La was determined in a target corresponding to 23.5 g of the original sample. The method described permits one to exploit fully the maximum sensitivity of the activation analysis.

Author (NSA)

N66-20582# Army Chemical Center, Edgewood, Md. Chemical Research and Development Labs.

QUANTUM-MECHANICAL CALCULATIONS. I: THE MODERN HUCKEL CALCULATION Technical Report, Feb.–Sep. 1964

P. Gary Mennitt and Wally P. Giordano Aug. 1965 31 p refs (CRDLR-3297; AD-627843) CFSTI: HC $2.00/MF $0.50

The Huckel-type quantum-mechanical calculation of molecular electronic systems was introduced as a tool in chemical pharmacology. Computer programs were developed at CRDL for molecular-orbital calculations. The highlights of the molecular-orbital theory (its mathematical, chemical, and physical foundation) are developed, followed by a detailed explanation of the use of the programs. Applications of the results to the analysis of chemical (chemical pharmacological) activity are introduced. The molecular-orbital procedure is illustrated for the important molecule 2-PAM (2-pyridine aldoxime methiodide). Author (TAB)

N66-20601# Naval Radiological Defense Lab., San Francisco, Calif.

QUANTITATIVE RADIOCHEMICAL DETERMINATION OF NICKEL-63 IN SEAWATER

Ming G. Lai and Harry A. Goya 3 Nov. 1965 21 p refs (Contract AT(49-5)-2084)

(USNRDL-TR-924; AD-627024) CFSTI: HC $1.00/MF $0.50

A liquid scintillation method for the quantitative determination of Ni63 in seawater is described. The method consists in complexing the nickel in seawater with dimethylglyoxime, extracting it into chloroform, and then back-extracting the nickel into an aqueous phase using dilute sulfuric acid. An aliquot of this sample is added to a scintillation solvent and counted in a liquid scintillation counter. Author (TAB)

N66-20603# Stanford Research Inst., Menlo Park, Calif.

GROWTH AND CHARACTERIZATION OF β-SILICON CARBIDE SINGLE CRYSTALS Scientific Report No. 2, Feb.–Sep. 1965

Walter E. Nelson, Arne Rosengreen, and Frank A. Halden Oct. 1965 25 p refs

(Contract AF 19(628)-4190)

(AFCRL-65-817; AD-627174) CFSTI: HC $1.00/MF $0.50

Changes in crystal size and morphology were obtained by modifying the process of growing crystals of beta-silicon carbide from solution in carbon-saturated melts. Well developed laths and plates were grown under conditions favoring dendritic growth mechanisms (low thermal gradient with moderate stirring). Polyhedral crystals grew under high thermal gradient conditions when high velocity stirring was employed. Three-dimensional type growth was also produced from a 73 wt% iron–silicon alloy under conditions that normally produce lath-type growth. Uncorrected electron mobilities of 700 to 1000 cm^2/v-sec were measured at room temperature, and a few preliminary Hall measurements were made over the temperature range from 77° to 300°K. Author (TAB)

N66-20605# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MECHANICAL IMPULSE TRANSMITTED TO ELECTRODES IN ELECTRIC DISCHARGE BETWEEN BIMETALLIC ELECTRODES

I. G. Nekrashevich and I. A. Bakuta 6 Jan. 1966 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk Belorussk. SSR, Ser. Fiz.-Tekhn. (Minsk), no. 2, 1964 p 47–50

(FTD-TT-65-1001/1+2+3+4; AD-627004) CFSTI: HC $1.00/MF $0.50

An experimental study of the electroerosion effect on composite bimetallic electrodes indicated that this effect is governed by the physical properties of all metals participating in the erosion event. The areas of the erosion pits and the deflection of the ballistic pendulum, which is proportional to the impulse imparted to the electrode on discharge in liquid were measured. The results obtained are accounted for by the structure of the discharge channel within the framework of the migration theory proposed earlier by the authors.

Author (TAB)

N66-20638# Research Triangle Inst., Durham, N. C.

PHOTOCHEMICAL N-DEALKYLATION REACTIONS OF ACTINOMYCIN ANALOGUES Final Report, 26 Dec. 1961–24 Sep. 1965

Monroe E. Wall [1965] 8 p refs

(Contract DA-31-124-ARO-D-169; Grant DA-ARO(D)-31-124-G250)

(AROD-3418-2; AD-625934) CFSTI: HC $1.00/MF $0.50

Conclusions: Irradiation of 2-monoalkylaminophenoxaz-3-ones leads to tetracyclic oxazolo or oxazolinophenoxazines depending on the constitution of the monoalkylamino substituent. The presence of a 2-dialkylamino substituent in the same

substrate increases the photo-reactivity of these phenoxazones, probably due to increased steric interaction with the ortho substituents. In this series also the initial step of the photochemical reaction appears to be that of hydrogen abstraction from the dialkylamino group by the excited quinone carbonyl group. The subsequent course of the reaction depends upon the nature of the dialkylamino group. This work provides a synthesis of novel pentacyclic compounds not easily accessible by other methods. The results indicate that the overall course of the photochemical reaction is influenced by the nature of the ortho substituent. Author (TAB)

N66-20657# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE HYDROLYSIS OF URANIUM MONONITRIDE
R. M. Dell, V. J. Wheeler, and E. J. Mc Iver Nov. 1965 35 p refs
(AERE-R-4984) CFSTI: HC $2.00/MF $0.50

The kinetics of hydrolysis of uranium mononitride in water vapor at 20-60 Torr have been measured from 340-420°C for powder samples prepared at 1450°C. Under suitable experimental conditions nitrogen is released quantitatively as ammonia according to the overall reaction: $UN+2H_2O \rightarrow UO_2+NH_3+1/2\ H_2$. The measured activation energy is ca 21kcal/mole. Some complication is introduced by the secondary reaction of ammonia with UN at 400°C to form U_2N_3. Author

N66-20661# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
INTERPRETATION OF THE CONDUCTIVITY OF POROUS AND DISPERSED MEDIA WITH THE AID OF CUBIC CELLULAR GEOMETRIC MODELS
P. Le Goff and C. Prost Jul. 1965 74 p refs Transl. into ENGLISH from FRENCH Presented at Symp. on Porous Media in Chem. Eng., Paris, 21–23 Apr. 1965; Sponsored by Soc. de Chem. Ind.
(AERE-TRANS-1038) CFSTI: HC $3.00/MF $0.75

The phenomena associated with fluid flow through a porous media are discussed, and their applications to chemical engineering are classified as (1) single fluid, and two-fluid flows through a porous medium with an invariable texture; (2) flow of suspensions, filtration; and (3) chemical reactions of porous solids. Various models devised to establish mathematical relationships between the porosity, the specific surface, the relative electrical conductivity, and the laminar permeability are examined. An experimental study of model conductivity was undertaken, using analog models to form a conducting medium with the required geometrical shape. The technique is described, and the data for each case considered are diagrammed. The empirical relationships obtained in previous studies are compared with the representative curves of the models, and the experimental points are plotted on the diagrams to describe the texture of each natural medium. It is pointed out that numerous formulas have been suggested, and that the complexity of the problem limits any strict mathematical treatment. Relative conductivities of dispersions are tabulated, and a bibliography is included. M.G.J.

N66-20675# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.
A STUDY OF ELECTRODES AND ELECTRODE REACTIONS. II: THE RELATION OF THE ENERGY NECESSARY TO REMOVE AN OXYGEN MOLECULE FROM CHARGED NICKEL OXIDE ELECTRODES IN VACUA AND SOLUTIONS OF POTASSIUM HYDROXIDE
Benjamin C. Bradshaw Dec. 1965 31 p refs
(ECOM-2646; AD-627216) CFSTI: HC $2.00/MF $0.50

The energies that are necessary to remove oxygen from charged nickel oxide electrodes that are in solutions of potassium hydroxide at 25°C were calculated. The 21 and 24 kilo calories that are necessary to release one mole of oxygen into potassium hydroxide solutions agree with the 21 and 24 kilo calories that are necessary to release it into vacua. The evolution of oxygen from charged nickel oxide electrodes into vacua obeys the equation describing first-order reactions, and seems to result from the simple decomposition of the higher oxides of nickel. The evolution of oxygen obeys the same equation with the same specific reaction rates when the electrodes are in solutions of potassium hydroxide that are saturated with oxygen. Therefore, it was concluded that the reduction of the higher oxides of nickel results from a simple decomposition in both, that the rate of reoxidation of the lower oxides of nickel is negligible, and that the energy of activation for this reoxidation is large relative to kT. The variation of the electromotive force is calculated as a function of the variation of the ratio of the concentrations of the oxidized and reduced nickel ions that are on the surface of the electrodes. Author (TAB)

N66-20693# United Kingdom Atomic Energy Authority, Harwell (England).
ASPECTS OF POLYPHENYL CHEMISTRY. PART V: HOMOLYTIC SUBSTITUTION OF BIPHENYL RADICALS IN BENZENE AND BIPHENYL
J. A. Cade and A. Pilbeam Nov. 1965 24 p refs
(AERE-R-3796)

Isomeric phenylbenzoyl peroxides were synthesized and allowed to decompose thermally in liquid biphenyl or benzene and biphenyl. From the isomer ratios of the neutral polyphenyl products, the rate of substitution of biphenyl radicals in biphenyl relative to benzene, together with the relative partial rate factors for the substitution reaction at various positions in the biphenyl nuceus were determined. The relevance of the results to an understanding of the mechanism of radiolysis of liquid biphenyl is discussed. Author

N66-20694# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
ASPECTS OF POLYPHENYL CHEMISTRY. PART IV: ISOMER RATIOS OF QUATERPHENYLS FORMED IN THE RADIOLYSIS OF LIQUID BIPHENYL IN A NUCLEAR REACTOR
J. A. Cade and A. Pilbeam Nov. 1965 30 p refs
(AERE-R-3797)

Several one-kilogram batches of pure biphenyl were irradiated for short periods, to obtain gram quantities of primary radiolysis products. The preliminary analysis of the high boiling polymer with particular reference to the isomer ratios of quaterphenyls formed is described. Author

N66-20696# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
CHEMICAL REACTION IN A BUBBLING GAS-FLUIDIZED BED
B. A. Partridge and P. N. Rowe Nov. 1965 59 p refs
(AERE-R-5036)

A two-phased model of a fluidized bed was used to predict the rate of chemical conversion from a gas-solids reaction and to establish design parameters for a fluidized-bed chemical reactor. Considered were only bubbling gas fluidized beds in which the bubbles rose faster than the remote interstitial gas, and thus formed clouds. The design problem was to chose the best catalyst and to find the bed height that will give the required degree of conversion for a 115 μ and a 230 μ catalyst. The coarser material proved more effective by achieving

a proportionally better contact with a larger quantity of cloud gas than the finer grained material. Calculated variations of chemical compositions with bed height depended on order and rate of reaction. It was found that general conclusions cannot be drawn from this example calculation. G.G.

N66-20698# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
STUDIES OF THE CALCINATION OF TWO BERYLLIA POWDERS
A. W. Hey and D. T. Livey Nov. 1965 30 p refs
AERE-R-5066)

Two beryllium oxide powders prepared by the decomposition of hydroxides with different impurity contents were calcined in air for various times at different temperatures. The kinetics of crystallite growth, the variation of surface area, and the variation of powder characteristics as observed by electron microscopy, were studied as a function of temperature. The kinetics of crystallite growth over the temperature range 600°-900°C were found to obey the relationship $D^n - D_0^n = Kt$ where n equalled 7 and 10 respectively for the two powders. Apparent activation energies in each case were ~61 k.cal/mol and ~46 k.cal/mol respectively. Based on the kinetic data and the evidence obtained from surface area measurements and electron microscopy, the crystallite growth process is discussed in terms of the mechanisms possible at these and higher temperatures. Author

N66-20708# Sheffield Univ. (England). Dept. of Chemistry.
DECAY OF THE TRIPLET STATE Final Technical Report
G. Porter and J. W. Hilpern 30 Sep. 1964 45 p refs
(Contract AF 61(052)-722)
(AFCRL-64-1017; AD-610783) CFSTI: HC $2.00/MF $0.50

Investigations of the triplet state of 9,10-halogen substituted anthracene by flash photolysis at temperatures from liquid nitrogen temperature to room temperature appear to indicate mechanistic differences between bromo and chloro substitution. Studies of biphenylene give evidence of emission to the ground state from the second triplet level and second excited singlet level. Author (TAB)

N66-20709# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CATALYSIS OVER AN ORGANIC SEMICONDUCTOR, OBTAINED ON THE BASIS OF POLYACRYLONITRILE
L. A. Lyatifova and M. M. Sakharova 13 May 1965 7 p refs
Transl. into ENGLISH from Dokl. Akad. Nauk Azerb. SSR (Baku), v. 20, no. 1, 1964 p 31-33
(FTD-TT-65-41/1+2; AD-615989) CFSTI: HC $1.00/MF $0.50

A study was made of the catalytic activity of the organic semiconductor nickel-doped polyacrylonitrile. The composition was found to catalyze the dehydrogenation of formic acid, but to have no catalytic effect on the decomposition of isopropanol. TAB

N66-20727 Cyananid European Research Inst., Geneva (Switzerland).
ORBITAL ENERGY DIFFERENCES AND CHEMICAL BONDING IN RARE EARTHS
C. Klixbüll Jorgensen *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 1-14 refs (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

The absorption spectra of lanthanide compounds show three types of transitions: internal transitions in the $4f^q$ configuration, where the very small shifts induced by the ligands (the nephelauxetic effect) allow conclusions on weak covalent bonding; transitions 4f—5d producing broader and more intense absorption bands; and electron transfer bands λ—4f strongly dependent on the reducing character of the ligands. A common theory for the variation with the number q of 4f electrons of the two latter categories explains why the wavenumbers are particularly low for q=8 and q=6, respectively. The behaviour of metallic alloys is discussed, and parenthetical remarks made about the 5f elements. The reluctance of lanthanides to change their oxidation state is connected with the very large effect of repulsion between 4f electrons. Author

N66-20728 Technische Hochschule Darmstadt (West Germany). Institut für Technische Physik.
OPTICAL SPECTROSCOPY OF RARE EARTH COMPOUNDS
K. H. Hellwege *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 15-26 refs (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

New results covering the following fields are presented: The term schemes of Nd^{3+} and Tb^{3+} ions have been investigated up to 40,000 cm^{-1}; the absorption spectrum of the $^2F_{5/2}$—$^2F_{7/2}$ transition in unhydrous $CeCl_3$ has been analyzed. An extensive study of magnetically ordered compounds has been undertaken ($GdCl_3$, DyAlG, ErIG, DyIG, HoIG); the internal fields for these compounds have been obtained in the ordered state. In La(Er)Cl_3 an example for the correlation of linewidth of fluorescence lines and the ORBACH coefficient is given. Author

N66-20729 Cyanamid European Research Inst., Geneva (Switzerland).
2,2'-DIPYRIDYL COMPLEXES OF RARE EARTHS. II: CHANGE IN FLUORESCENCE INTENSITIES OF EUROPIUM AND TERBIUM CHELATES ON LIGAND SUBSTITUTION
S. P. Sinha *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 29-39 (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

A semiquantitative comparison of fluorescence intensities of unsubstituted and para dimethyl substituted dipyridyl chelates of trivalent europium and terbium is presented. The electron donating methyl groups increase the overall intensity for both europium and terbium chelates. However, in case of europium the intensity ratio $\eta_{Dimp/Dip}$ for the two transitions from $^5D_0$ to $^7F_1$ and $^7F_2$ levels are not of the same order of magnitude. The $\eta_{Dimp/Dip}$ values for all transitions of terbium are roughly the same. Author

N66-20730 General Telephone and Electronics Labs., Inc., Bayside, N. Y.
COORDINATION AND CHEMICAL EQUILIBRIUM IN CHELATE LASER MATERIALS
H. Samelson, C. Brecher, and A. Lempicki *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 41-52 refs (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

Chelated rare earth ions have been found to exist in solution in a multiplicity of molecular structures, differing in the number and geometrical arrangement of coordinating ligands. Eight-fold coordination is the most common, but changes in temperature, solvent, or substituent groups may alter the coordination in either direction. Furthermore, most chelates dissociate progressively further as their concentration is lowered. The ramifications of such behavior on their luminescence and laser applications will be discussed. Author

N66-20731 Westinghouse Electric Corp., Bloomfield, N. J. Lamp Div.

OPTIMUM ACTIVATOR CONCENTRATIONS IN RARE-EARTH OXIDE PHOSPHORS

R. C. Ropp *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book I: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 53–63 refs (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

The intensity of fluorescence of rare-earth activators in rare-earth oxide phosphors is an inverse function of the degree of ground-state splitting which occurs, and also of the degree of resonance energy interaction between ions within the lattice. Such phenomena probably account for the completely different optimum concentration observed for the various activators studied. Author

N66-20732 Dupont de Nemours (E. I.) and Co., Wilmington, Del. Central Research Dept.

EFFICIENCY OF Eu^{+3} FLUORESCENCE IN OXYGEN-DOMINATED HOST LATTICES

Hans J. Borchardt *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book I: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 65–75 refs (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

The efficiency of Eu^{+3} fluorescence in a variety of rare earth oxygen-dominated host materials was measured under excitation by 2537 Å UV at 25°C. It was found to be of the same order as that of the commercial phosphor magnesium arsenate: Mn in all such hosts. To account for the insensitiveness of efficiency to the nature of the host lattice, it is proposed that europium-oxygen states are excited directly and that the corresponding absorption coefficient is of a magnitude to make this the dominant absorption process. Independent evidence for europium-oxygen charge-transfer absorption is given. Author

N66-20733 General Telephone and Electronics Labs., Inc., Bayside, N. Y.

ON THE ENHANCEMENT OF THE FLUORESCENCE OF AQUEOUS SOLUTIONS OF NEODYMIUM, SAMARIUM AND DYSPROSIUM CHLORIDES

Adam Heller *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 77–85 refs Prepared in part at Bell Telephone Labs., Murray Hill, N. J. (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

Substituton of H_2O by D_2O enhances the fluorescence of aqueous solutions of the chlorides of trivalent neodymium, samarium and dysprosium. The fluorescence of the two latter weakly absorbing ions is further intensified by energy transfer from water soluble organic compounds in their triplet state. The minimum deuteration enhancement factors are four for neodymium, fourteen for samarium and one hundred for dysprosium. The sensitizing triplets enhance the fluorescence of samarium and dysprosium by an order of magnitude. The emission spectra of the H_2O, D_2O, sensitized or unsensitized solutions of any of the ions are identical. The dominant emission lines are 10,550 Å for neodymium, 5947 Å for samarium and 4795 Å for dysprosium. Author

N66-20734 Cyanamid European Research Inst., Geneva (Switzerland).

LOW-TEMPERATURE OPTICAL STUDIES OF RARE-EARTH CYCLOPENTADIENIDES

R. Pappalardo *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 87–98 refs (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

A systematic study of the optical properties of rare-earth cyclopentadienides was started. These compounds, where the rare-earth ion is bound to a five-membered aromatic ring, are very air sensitive. This required the use of suitable handling techniques in order to take absorption spectra at low temperatures. Most rare-earth tricyclopentadienides have been studied at 78°K, both as sublimed films and as solutions in 2 Me-THF. The spectrum of $Ndcp_3$ has been studied in detail at liquid helium temperatures. Many of the undiluted rare-earth cyclopentadienides show fluorescence associated with the aromatic ligand ($Gdcp_3$; $Cecp_3$; $Lacp_3$; $Eucp_2$) and broad absorption bands at rather low energies. A complex chemistry is shown by Ytterbium in its reactions with cyclopentadiene. The composition of sublimed phases is discussed on the basis of their infrared and optical spectra. Author

N66-20735 Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.

SPECTROSCOPIC STUDY OF CERIUM IN YTTRIUM GALLIUM AND YTTRIUM IRON GARNET

K. A. Wickersheim and R. A. Buchanan (Naval Ordnance Lab., Corona, Calif.) *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 99–110 refs Prepared in cooperation with Naval Ordnance Lab. (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

A fundamental problem in magnetism is the origin and description of the exchange interaction between magnetic ions. The development of an exchange field formalism, applicable to the rare earth ions in the rare earth iron garnets, is reviewed. It is shown that further progress depends upon a more complete solution of the crystal field problem and on the acquisition of more experimental exchange splittings for specific rare earth ions. The advantages of using cerium as a "probe" to provide the necessary information are discussed. Cerium and ytterbium are compared, and spectroscopic results for cerium substituted into both yttrium gallium and yttrium iron garnet are presented. Especially noteworthy are (a) the large size of the crystal field splittings (of the order of 1500 cm^{-1} for the J=7/2 state), (b) the large size of the exchange splittings of the Kramer's doublets (of the order of 200 cm^{-1}) and (c) the general sharpness of the cerium spectra. Author

N66-20736 Queen's Coll., Dundee (Scotland). Dept. of Chemistry.

SOME NEW ELECTRON-TRANSFER SPECTRA OF TRIVALENT LANTHANIDES

John C. Barnes and Hugh Pincott *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 111–121 refs (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

Electron transfer spectra are presented for the compounds $LnPO_4$, $Ln_2(CO_3)_3$, $Ln_2(oxalate)_3\ 10H_2O$ and several compounds containing sulphate or halide ion. Ln=Sm, Eu and Yb. The consequence of change in coordination number and structure are discussed. Oxyanion have very similar optical electronegativities, which do not correlate with their oxidation potentials. Author

N66-20738 Louisiana State Univ., New Orleans. Dept. of Chemistry.

SPECTRAL CHARACTERISTICS OF ND^{3+} AND Er^{3+} TRIETHYLENETETRAMINEHEXAACETIC ACID COMPLEXES

E. A. Boudreaux and A. K. Mukherji *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 139–150 refs (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

A new series of stable rare earth chelates with triethylene-tetramine-hexaacetic acid (TTHA) have been prepared in aqueous solution. Those of Nd^{3+} and Er^{3+} show particularly striking intensification of the $^4G_{5/2}$ and $^4G_{11/2}$ absorption bands respectively. In all cases the rare earth ion–TTHA stoichiometry is 1:1, and on making reasonable assumptions about the complex having the common nine-fold coordination of D_{3h} symmetry, the rationalization of these observations in terms of a weak covalent bonding interaction does not seem reasonable. However, the mechanism of pseudo-quadrupole interaction at the rare earth ion may perhaps offer a plausible explanation. Author

N66-20739 Allahabad Univ. (India). Chemical Labs.
SOME CHROMOGENIC REAGENTS FOR THE LANTHANOIDS
Arun K. Dey, Surendra N. Sinha, Satendra P. Sangal, and Kailash N. Munshi *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 151–162 refs Supported in part by the Council of Sci. and Ind. Res., New Delhi (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

The use of Alizarin Red S, Chromotrope 2B, 4-(2-pyridylazo) resorcinol, 2-(p-sulphophenylazo)-1:8-dihydroxynaphthalene-3:6-disulphonate, Thoron, Chrome Azurol S, Aluminon and Xylenol Orange, as chromogenic reagents for the lanthanoids has been described. They are sensitive, but not selective for the rare earths. Xylenol Orange and 2-(p-sulphophenylazo)-1:8 dihydroxynaphthalene 3:6-disulphonate are particularly suitable, the former being highly sensitive and the latter being more tolerant towards other cations. Author

N66-20752# Iowa State Univ. of Science and Technology, Ames. Institute for Atomic Research.
FIFTH RARE EARTH RESEARCH CONFERENCE. BOOK THREE: CHEMISTRY SESSION C
[1965] 137 p refs Conf. held 30–31 Aug. 1965 Sponsored in part by AFOSR
(Grant AF-AFOSR-812-65)
(AFOSR-65-1917, Bk. 3; AD-627223) CFSTI: HC $4.00/MF $1.00

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12. KINETIC STUDIES ON EXTRACTION OF EUROPIUM BY LITHIUM AMALGAM AND COMPARISON TO REMOVAL BY ELECTROLYSIS E. I. Onstott and J. F. Goddard (Los Alamos Sci. Lab.) p 119–127 refs (See N66-20764 10-06)

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N66-20753 Paris Univ. (France). Inorganic Chemistry Lab.
CRYSTAL CHEMISTRY OF THE SULFIDES, SELENIDES AND TELLURIDES OF THE RARE EARTHS AND YTTRIUM
Jean Flahaut *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 1–12 refs (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

A general survey is presented of the observed phases in the L_2X_3 compounds. Descriptions of the following new compounds and new crystal structures are given: L_6S_7 compounds of the monoclinic Y_6S_7 type (Dy to Tm) crystal structure; rhomboedral L_3Se_4 compounds (Ho to Lu), relations with the NaCl structure; tetragonal LTe_2 tellurides (La to Dy) and pseudo tetragonal LTe_3 tellurides (La to Tm, and Y); $L_2O_2S_2$ oxydisulfides (La to Nd) and $L_2O_2Se_2$ oxydiselenides (La to Dy); and LSI sulfoiodides and LSeI selenoidides. Observed were the intermediate compounds between rare earth L_2X_3 sulfides or selenides and MX sulfides or selenides. In the wide range solid solution studies, starting from a cubic phase of NaCl type, two successive superstructures develop, first cubic then rhomboedral. They have been only observed in CaS-Yb_2S_3 and CaS-Lu_2S_3 systems, in CaSe-L_2Se_3 systems with L=Dy to Lu, and in YbSe-Yb_2Se_3 system.
M.R.W.

N66-20754 Arizona State Univ., Tempe. Dept. of Chemistry.
ON THE MONOXIDE OF SAMARIUM
Theron L. Felmlee and Le Roy Eyring *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 13–24 refs Sponsored by AEC (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

A method of preparation was developed for samarium monoxide of NaCl-type structure. Compounds were prepared with two different colors: a deep red preparation with a lattice parameter a_o=4.988 ±0.002 Å, and a gold colored product with a_o=4.9784 ±0.0005. The gross composition of the compounds was established as SmO. A comparison of these results with previous reports is made, and a discussion of

trends in the behavior of rare earth chalcogenides which give the anomalously low lattice parameter for SmO is discussed. Author

N66-20755 Freiburg Univ. (West Germany). Chemistry Lab.
MIXED CRYSTAL PHASES WITH PRASEODYMIUM DIOXIDE
Gerog Brauer and Burkhard Pfeiffer *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 25–35 refs (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

Praseodymium oxide was combined with the sesquioxides of La, Nd, Sm, Gd, Dy and Er. The oxide mixtures with graduated compositions were heated at about 400°C to give mixed crystals, the gaseous medium being pure oxygen of 10 atm pressure. Hence, the praseodymium has a high valency near PrO_2 and extended mixed crystal series occur with a defect lattice closely related to the fluorite type structure. A discussion is given how the oxygen dissociation pressure depends on the composition of the ternary oxide phases. Author

N66-20756 Babcock and Wilcox Co., Alliance, Ohio.
PREPARATION AND SOME PROPERTIES OF SODIUM-RARE EARTH MIXED OXIDES
Karl S. Vorres *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 37–41 refs Sponsored by AEC and ARPA Work performed at Purdue Univ. (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

Mixtures of Na_2CO_3 and oxides if Y, La, Nd, Gd, Dy, Ho, Er or Yb were heated in a dry oxygen or nitrogen stream at 880°C for 15 hours. Reactions took place in all cases yielding products of the type $Na(RE)O_2$. The X-ray data indicated five different structure types. Author

N66-20757 General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
CRYSTAL STRUCTURE OF THE RHOMBOHEDRAL MO_3-$3R_2O_3$ COMPOUNDS (M=U, W, AND MO) AND THEIR RELATION TO ORDERED R_7O_{12} PHASES
S. F. Bartram *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 43–54 refs (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

A complete three-dimensional structure analysis of the mixed oxide UO_3-$3Y_2O_3$ was carried out using single crystal data. This structure is characteristic of a large family of rhombohedral compounds containing rare earth oxides and having an oxygen-to-metal ratio of 12:7. Bond lengths and coordination polyhedra for the atoms in the rhombohedral structure are compared with those in other known oxides. The relationship between $U_mY_{7-m}O_{12}$ compositions ($1<m<2.0$) and ordered $RO_{1.71}$ phases is shown. Some conclusions are drawn as to their mode of oxidation. Author

N66-20758 Cincinnati Univ., Ohio.
NONSTOICHIOMETRY OF UO_2-CeO_2: THE SYSTEM UO_2-CeO_2-$CeO_{1.5}$ AT 900–1200°C
Michael Hoch and Francis J. Furman *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 55–65 refs (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

This investigation covers the substoichiometric fluorite (UO_2-CeO_2) phase, that is, the behavior of the system $U_{1-y}Ce_yO_{2+x}$. Though UO_2 and CeO_2 are completely miscible, and in the CeO_2-$CeO_{1.5}$ system the fluorite phase extends to $CeO_{1.72}$, the UO_2-CeO_2-$CeO_{1.5}$ system is characterized by a large two phase region, where two fluorite type structures, one CeO_2 rich, the other UO_2 rich, coexist. Only in the UO_2 rich corner of the ternary system is a noticeable single phase region present. This is in contrast to the CeO_2-UO_2-$UO_{2.67}$ system where a large single phase region exists. The oxygen activity as a function of composition x was measured in $U_{1-y}Ce_yO_{2+x}$ (y=.15 and .35), at 900° C using H_2/H_2O and metal/metal oxide equilibria. In all cases, the oxygen activity increases extremely rapidly with decreasing x: the behavior of the system resembles that of dilute solutions of UO_{2+x} in ThO_2. Both systems can be explained by assuming defect complexes: a vacancy bound to two Ce^{3+}, an interstitial oxygen bound to two U^{5+}. Author

N66-20759 Iowa State Univ. of Science and Tecnology, Ames. Inst. for Atomic Research.
THE SUCCESSIVE STABILITIES OF THE RARE EARTH 1-HYDROXYCYCLOPENTANE CARBOXYLIC ACID CHELATES
J. E. Powell and D. L. G. Rowlands *In its* 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 67–77 refs Sponsored in part by AEC (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

The formation constants of the first three chelate species of the tripositive rare-earth cations with the 1-hydroxycyclopentane-carboxylic (HCPC) acid ligand have been determined. Some values of b_4 have also been reported where calculable. Measurement was by a potentiometric method at 25°C, and the ionic medium was maintained at $\mu=0.1$ by the supporting electrolyte, sodium perchlorate. Ionization constants of the acid were also determined over the same ligand range. From the stability constant ratios, and hydration data of solid species, obtained using a thermobalance technique, an effort was made to postulate the coordination number in the complex and the dentate character of the ligand, based on the nine-coordinate, trigonal prism +3 model. Author

N66-20760 TRG, Inc., Melville, N. Y.
ACETYLACETONATES OF TRANSITION METALS AND RARE EARTH METALS
J. J. Sjoblom *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem Session C [1965] p 79–86 refs (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00 (Contract AF 49(638)-673; Proj. Defender)

Crystalline metal acetylacetonates were investigated to find experimental media containing spectral line emitters such as chromic ion and europium or dysprosium ion. Procedures were worked out for the preparation of pure crystalline acetylacetonates of aluminum, chromium, yttrium, europium, dysprosium, the aluminum and yttrium chelates to serve as host crystals. A method was devised for growing crystals of aluminum acetylacetonate doped with chormic acetylacetonate. In addition, molecular metal chelates were believed capable of existence in solid solution with a dissimilar diluent. However, experimental tests of this solid solution type have brought out its limitations. Author

N66-02761 Centre National de la Recherche Scientifique, Bellevue (France). Laboratoire des Terres Rares.
SEPARATION OF RARE EARTH ELEMENTS BY THE RELATIVE SOLUBILITY OF THEIR CARBONATES IN CARBONATED WATER [SEPARATION DES ELEMENTS DES TERRES RARES PAR SOLUBILITE RELATIVE DE LEURS CARBONATES DANS L'EAU CHARGEE DE GAZ CARBONIQUE]
F. Trombe and P. Caro *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 87–98 refs In FRENCH (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

The relative solubility of rare earth and yttrium carbonates was measured. Yttrium carbonate was found to be considerably more soluble than the rare earths; for example, a mixture with 8% of yttrium is in equilibrium with a solution containing 28% of dissolved yttrium carbonate. It is pointed out, however, that the yield of the extraction is very small because of the weak solubility of the carbonates. A metatectic reaction of the type $Y_2(CO_3)_3+2\ NdCl_3 \rightarrow Nd_2(CO_3)_3+2\ YCl_3$ permits considerable augmentation of the mass of yttrium extracted from the mixture while conserving the equilibrium proportions. The metatectic reaction is brought about simply by the introduction of a small quantity acid, which dissolves part of the mixture, into the solution. Transl. by D.T.

N66-20762 Los Alamos Scientific Lab., N. Mex.
PREPARATION OF THE CARBONATES OF THE RARE EARTHS FROM SOME OF THEIR ORGANIC ACID SALTS
E. L. Head *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 99–105 refs Sponsored by AEC (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

A method which permits the preparation of the sesquicarbonates of all of the rare earths and yttrium from certain organic acid salts of the rare earths is described. Specifically, application of CO_2 pressure to aqueous solutions of the formates, acetates, propionates, and butyrates will produce the rare earth carbonates. Although this method will produce the normal carbonates at 23°C, the application of heat increases the yield and filterability of the product. The composition and yields of the products prepared from the acetates and propionates are given; the yields ranged generally in the vicinity of 50 to 60%. Impurity due to the organic acid group may range from virtually zero percent in the case of Lu and Yb up to 1 or 2 percent by weight in some of the other products. In addition to the hydrates normally reported for the carbonates the heptahydrate of Er, the penta- to hexahydrate of Yb, and the hexahydrate of Lu were prepared. X-ray powder patterns were obtained of all of the carbonates prepared from the propionates. Author

N66-20763 Ludwig-Maximilians-Universitat, Munich (West Germany). Institut für Anorganische Chemie.
PREPARATION AND PROPERTIES OF PROMETHIUM AND SOME OF ITS COMPOUNDS
Fritz Weigel *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 107–118 refs (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

Metallic promethium was prepared by reduction of PmF_3 with lithium in vacuo at 750° and annealing at 1200° C. The metal is silvery white, its X-ray diffraction pattern has not yet been fully interpreted. An attempt was made to determine the melting point by means of McWhan's "solder-rupture" method. A value of 865 ±40° C was found as the average of four determinations. The following compounds of promethium were prepared: PmF_3, $PmCl_3$, $PmCl_3{\cdot}xH_2O$, PmOF, Pm_2O_3 (A-, B-, and C-type), $Pm(OH)_3$, $Pm(NO_3)_3{\cdot}xH_2O$, $PmPO_4{\cdot}(0..0.5)H_2O$, $PmPO_4$, $PmAsO_4$, $Pm(JO_3)_3{\cdot}xH_2O$, $Pm_2(C_2O_4)_3{\cdot}10H_2O$, $Pm_2(CrO_4)_3$, $PmCrO_3$, $Pm_2(MoO_4)_3$, and $Pm_2(WO_4)_3$. The lattice constants of most of these compounds were determined. In the case of $Pm_2(WO_4)_3$ the tungsten bremsstrahlung excited by the 223 keV B's of Pm^{147} was studied. The internal target yield in the system Pm_2O_3-WO_3 was measured. With increasing WO_3-concentration, this yield increases steadily. The possible application of Pm_2O_3-WO_3 phases as γ-sources with defined spectrum is discussed. Author

N66-20764 Los Alamos Scientific Lab., N. Mex.
KINETIC STUDIES ON EXTRACTION OF EUROPIUM BY LITHIUM AMALGAM AND COMPARISON TO REMOVAL BY ELECTROLYSIS
E. I. Onstott and John F. Goddard *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 119–127 refs Sponsored in part by AEC (See N66-20752 10-06) CFSTI: HC $4.00/MF $1.00

Extraction of Eu by saturated lithium amalgam from aqueous lithium citrate electrolytes containing a preponderance of Gd proceeds linearly with time after an initial much more rapid extraction of a fraction of the Eu present in the electrolyte. When ammonium ion is substituted for lithium ion in the electrolyte, the initial rapid extraction of Eu is reduced by a factor of two to three, but subsequent steady-state extraction is virtually nil. The amount of Eu in the initial faster reaction depends on the method of contacting the phases. About twice as much Eu is extracted when the amalgam is dumped into the electrolyte compared to the reverse procedure of adding the electrolyte to the amalgam. Removal of Eu by electrolysis from aqueous lithium citrate electrolytes containing a preponderance of Gd starting with pure mercury (lithium amalgam cathode method) is linear with time at constant current density for short electrolysis times. The rate of removal increases as the current density is increased. No initial very rapid removal of Eu by electrolysis is observed. When ammonium ion is substituted for lithium ion in electrolytes, the removal of Eu by electrolysis is a factor of about 1500 slower than with lithium ion present and ammonium ion absent. Author

N66-20785 Texas Univ., Austin. Dept. of Chemical Engineering.
THE CRYSTAL CHEMISTRY OF THE INTERMEDIATE PHASES IN THE YTTERBIUM-ANTIMONY SYSTEM
Raymond E. Bodnar and Hugo Steinfink *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 5: Met. Session M [1965] p 57-66 refs (See N66-20779 10-17) CFSTI: HC $4.00/MF $1.00

Seven intermediate phases have been synthesized in the ytterbium-antimony system and their crystal chemistry and physical properties are under investigation. A partially comantimony has the stoichiometry $YbSb_2$. It is orthorhombic, a=4.54 Å, b=4.26 Å, c=16.63 Å, space group Bmmb. It crystallizes in a tabular habit and shows pronounced cleavage, but its crystal structure has not yet been determined. The compound melts congruently at 945° C. The phase YbSb has the NaCl structure, a=6.082 Å, and melts congruently at 900° C. Another phase with the probable composition Yb_5Sb_4 is orthorhombic, a=8.10 Å, b=15.97 Å, c=24.30 Å, space group Pnma. It melts incongruently at 1350°C. Yb_4Sb_3 has the inverted Th_3P_4 structure, a=9.30 Å, space group $I\bar{4}3d$, and displays no solid solubility. It melts congruently at 1540°C. The intermediate phase Yb_5Sb_3 is formed during high temperature reactions and appears to have a narrow temperature range of stability. It is hexagonal, a=8.97 Å, c=6.91 Å, space group $P\bar{6}_3cm$ and is isostructural with Mn_5Si_3. It melts incongruently at 1520°C. Author

N66-20788 General Electric Co., Schenectady, N. Y. Research Lab.
SOLID-STATE ELECTROLYSIS OF GADOLINIUM
C. D. Graham, Jr. *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 5: Met. Session M [1965] p 89–99 refs (See N66-20769 10-17) CFSTI: HC $4.00/MF $1.00

Experiments have shown that the oxygen contents of gadolinium can be reduced by solid state electrolysis. In this method a direct current is passed through a solid rod of gadolinium at a temperature near the melting point. Oxygen moves toward the electrically positive end of the sample. The apparatus used in the experiments is described, and metallographic evidence of the effectiveness of the process is presented. A metallographic technique for gadolinium and other rare earths is described. Author

N66-20789 Iowa State Univ. of Science and Technology, Ames.
ELECTROTRANSPORT OF INTERSTITIAL ATOMS IN YTTRIUM
O. N. Carlson, F. A. Schmidt, and D. T. Peterson *In its* Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 5: Met. Session M [1965] p 101-118 refs (See N66-20779 10-17) CFSTI: HC $4.00/MF $1.00

The electrotransport velocities of carbon, oxygen and nitrogen in yttrium were determined in the temperature range of 1235° to 1460° C. Diffusion coefficients and effective charges were calculated for these elements for the same temperatures. Yttrium metal purified by the electrotransport method showed a decrease in oxygen content from 780 to 90 ppm and an increase in the resistance ratio from 12 to 45. Author

N66-20808# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
THEORETICAL AND QUANTUM CHEMISTRY OF N, O, F COMPOUNDS Quarterly Technical Report, 9 Oct. 1965-9 Jan. 1966
Joyce J. Kaufman [1966] 26 p refs
(Contract DA-31-124-ARO(D)-203; ARPA Order 542)
(QTR-7; AD-626184) CFSTI: HC $2.00/MF $0.50

The objective of the research is to investigate the theoretical and quantum chemistry of energetic N, O, F compounds with the aim of providing understanding of the fundamental bonding and behavior of these species. The goal is to establish the validity of and the criteria for using various theoretical techniques for the prediction of pertinent properties of these compounds. A new molecular SCF program is being written to replace the POLYATOM program. The chain which evaluates all integrals arising from d orbitals was rewritten. Calculational results by a modified three-dimensional 'extended Huckel' LCAO-MO procedure show good agreement with the experimental behavior and properties of O and OF compounds. Bond energies, bond lengths, infrared frequencies, ionization potentials, absorption spectra and fluorinating power all correlate well with the calculational results for overlap populations and energy levels. TAB

N66-20840# Ohio State Univ., Research Foundation, Columbus.
THE PHOTOCHEMICAL SYNTHESIS OF POLYAZACYCLOBUTANE SYSTEMS Final Report, 15 Nov. 1963-31 Aug. 1965
Michael P. Cava 8 Nov. 1965 13 p refs
(Grant DA-ARO(D)-31-124-G392)
(AROD-3631-1; AD-625218) CFSTI: HC $1.00/MF $0.50

Nineteen Schiff bases, both acyclic and cyclic, were prepared in order to study their behavior on ultraviolet irradiation (a) in the solid state and (b) in solution, (c) both in the presence and absence of oxygen and (d) with and without a Pyrex filter. Most of the Schiff bases were found to be remarkably stable to ultraviolet light and only the starting materials could be isolated. (On prolonged irradiation, dark brown tarry products were also formed.) In contrast, irradiation of the Schiff base formed from 1-naphthaldehyde and 1-naphthyl amine gave dibenzo[c,k]phenanthridine; similarly, the Schiff base from 1-naphthaldehyde and toluidine gave the analogous phenanthridine. 1,2,5-Naptho[b]thiadiazole was synthesized and photolyzed in the hope that 1,2-diazanaphtho[b]cyclobutadiene might be produced, but photodimerization of the thiadiazole was the only reaction observed. Finally, a new photolytic decomposition of benzylic sulfones was discovered and investigated in detail. Author (TAB)

N66-20873*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
AN ASSOCIATED SOLVENT THEORY OF POLYMER SOLUTIONS
W. Byers Brown and William D. Taylor 16 Feb. 1966 34 p refs
(Grant NsG-275-62)
(NASA-CR-71146; WIS-TCI-160) CFSTI: HC $2.00/MF $0.50 CSCL 07D

This paper describes an association theory of the thermodynamic properties of mixtures of a non-polar polymer with a polar solvent, based on the Flory-Huggins equation. The solvent molecules are assumed to associate to linear complexes which form an athermal Flory-Huggins mixture, while the polymer and the solvent complexes form a Flory-Huggins mixture with a single interchange energy parameter. The experimental dilution properties of mixtures of polypropylene with diethylketone and with di-isopropyl ketone, obtained from vapour pressure measurements, are shown to be satisfactorily described by the theory. The volumes of mixing exhibit the cubic type of dependence on composition possible theoretically, but the value of the Flory-Huggins parameter required is inconsistent with the other dilution properties. Author

N66-20877*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
PERTURBATION THEORY OF CONSTRAINTS: APPLICATION TO A LITHIUM HYDRIDE CALCULATION
D. P. Chong and W. Byers Brown 22 Feb. 1966 24 p refs (Grant NsG-275-62)
(NASA-CR-71159; WIS-TCI-157) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The perturbation theory of the constrained variational method is applied to a calculation on the lithium hydride molecule. The changes in various properties on constraining the expectation values of force and virial operators to vanish are calculated. It is shown that the perturbation series converge very rapidly, so that only the leading terms are required. However, in this particular case the imposition of the constraints has a negligible effect on the calculated properties. Author

N66-20918# United Kingdom Atomic Energy Authority, Wantage (England). Isotope Research Div.
STANDARDISATION OF Ca^{47}/Sc^{47}
J. E. Hiscott Nov. 1965 23 p refs
(AERE-R-4886) HMSO: 3s

A method of standardising Ca^{47}/Sc^{47}, with the estimation of low concentrations of Ca^{45} in the Ca^{47}/Sc^{47} solution is outlined. Equations relating count rates at any time after a reference time, and the activities of the three isotopes at the reference time are established and the analysis of sets of equations to find the optimum solution is described. Investigations on the accuracy of measurement of the Ca^{47} content, and the reliability of detection of low level Ca^{45} content are described, and the minimum duration of counting required to obtain a reproducible solution is discussed. It is estimated

that from five days counting the accuracy of the Ca^{47} and Sc^{47} activities is better than 2%, and an upper limit of the Ca^{45} concentration can be stated. Author

N66-20919 National Defense Research Organization T.N.O., The Hague (Netherlands). Chemical Lab.
SYNTHESES AND TOXICITIES OF SOME SERIES OF CHOLINESTERASE INHIBITING AGENTS. XII. A NEW METHOD FOR THE PREPARATION OF ALKYL METHYLPHOSPHONOFLUORIDATES
H. L. Boter Jan. 1966 19 p refs *Its* Rept.-1966-1
(TDCK-44552) CFSTI: HC $1.00/MF $0.50

Some alkyl methylphosphonofluoridates were prepared by the reaction of the dicyclohexylamine salts of the corresponding O-alkyl methylphosphonothioic acids with 2,4,6-trinitrofluorobenzene in acetone solution. All operations were carried out at room temperature. Yields varied from 66–83%. Purities, determined by gaschromatographic analyses, varied from 96–100%. The mechanism of the reaction is discussed. The effectiveness of 2,4,6-trinitrofluorobenzene as the fluorinating agent was compared with those of 2,4-dinitrofluorobenzene and 4-nitrofluorobenzene. One of the advantages of the synthetic route, described in this report, seems to be the easy way in which t.butyl methylphosphonofluoridate was isolated. This compound, which is difficult to obtain otherwise, pyrolyzed quickly at 75°, yielding methylphosphonic monofluoride and 2-methylpropene. Author

N66-20923# European Atomic Energy Community, Brussels (Belgium).
SPECTROGRAPHIC DETERMINATION OF URANIUM IMPURITIES BY CARRIER DISTILLATION [CONTRIBUTION A L'ETUDE DU DOSAGE SPECTROGRAPHIQUE DES IMPURETES DANS L'URANIUM PAR LA METHODE DE DISTILLATION AVEC ENTRAINEUR]
G. Ceccarelli Feb. 1966 26 p refs In FRENCH; ENGLISH Summary
(EUR-2647.f) CFSTI: HC $2.00/MF $0.50

Impurities are detected in uranium by a carrier distillation modified method. The essential modification consists in a longer exposure time (100 sec.). This permits obtaining the distillation curve for all elements by vertical displacement of the plate each 25 seconds, with a remarkable improvement of the precision and the reproductibility. The upper limits of concentration given by the classic method are lowered. The application of our working procedure to the other refractory compounds could eliminate their matrix effects. Author

N66-20927*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY TO THE STUDY OF SURFACE DEFECTS AND ADSORBED MOLECULES
Jack H. Lunsford and John P. Jayne Washington, NASA, Mar. 1966 29 p refs
(NASA-TN-D-3355) CFSTI: HC $0.30/MF $0.50 CSCL 07C

A summary of electron paramagnetic resonance theory of free radicals is made and applied to adsorbed gas molecules. The spectra of carbon dioxide and oxygen on magnesium oxide powders are determined. The magnesium oxide was degassed and ultraviolet irradiated prior to the addition of carbon dioxide and oxygen. Ultraviolet irradiation produced a center that is ascribed to an electron trapped in an anion-cation divacancy on the surfaces of the magnesium oxide powder. This center interacts with carbon dioxide and oxygen to form radicals which are thought to be CO_2^- and O_2^- molecule ions. The spectrum of oxygen on zinc oxide was observed and is also attributed to the O_2^- molecule ion. Carbon monoxide gas adsorbs as a paramagnetic species on unirradiated magnesium oxide. Author

N66-20939*# National Aeronautics and Space Administration, Washington, D. C.
CALCULATION OF VISCOSITY IN MOLTEN SALTS (OXIDES)
O. K. Sokolov Mar. 1966 13 p refs Transl. into ENGLISH from Izv., Nysshikh Uchebn. Zavedenii, Isvet. Met. (Dzaudzhikau), v. 5, no. 1, 1962 p 89–93
(NASA-TT-F-416) CFSTI: HC $0.10/MF $0.50 CSCL 07D

The author derives an equation based on Coulomb's law for calculating the viscosity of molten salts (oxides) in which there are two or fewer anions per cation. Viscosities calculated on the basis of this equation agree satisfactorily with experimental data. Tables are given showing viscosities calculated on the basis of this formula for several salts for which there are no empirical data. Author

N66-20942*# Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
INVESTIGATION OF BATTERY ACTIVE NICKEL OXIDES
P. Ritterman and H. N. Seiger [1965] 51 p refs
(Contract NAS3-7620)
(NASA-CR-54903) CFSTI: HC $3.00/MF $0.50 CSCL 10C

X-ray studies of sintered plate nickel oxide electrodes indicated that no noticeable structure change occurs until the electrode is at least 75% charged. This was true for both the C/2 and C/10 rate. Electrodes impregnated with nickel nitrate containing 20 metal atom percent of cobalt have been tested. These appear to have better charge retention characteristics at elevated temperatures. The utilization of active material (based on weight gain) is also quite high. Three groups of positive electrodes have been given three formation cycles, with the following conditions: (1) 10°C at C/30, (2) 80°C at C/10, and (3) 25°C at C/10, the first two groups having previously been shown superior on stand, the last group serving as a control. Author

N66-20989*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
PHOTOMETRIC MEASUREMENTS OF SIMULATED LUNAR SURFACES Quarterly Progress Report No. 2, 1 Oct.–31 Dec. 1965
J. D. Halajian and F. A. Spagnolo Jan. 1966 104 p refs
(Contract NAS9-3182)
(NASA-CR-65263; RM-308) CFSTI: HC $4.00/MF $0.75 CSCL 07D

Consideration is given to spectral photometry, photometry, of suspended particles, and the geometry of backscattering surfaces in a study on photometric measurements of simulated lunar surfaces. In the spectral photometry area it is reported that albedo and photometric measurements of all natural specimens at specified viewing angles and wavelengths were completed. Spectral responses of the photometric system and the sun-sensor systems used in lunar observations are discussed. A preliminary comparison of test results with available lunar data reveals certain similarities in albedo versus color behavior, and in the "opposition" region of the brightness-phase angle curve. In the second area, photometric properties of suspended particles were measured at various particle spacing to diameter ratios. Relative to the geometry of backscattering surfaces, a computer program designed to determine the closest photometric match of the lunar surface with four contrived geometries under a wide range of boundary conditions was completed. Results confirm

previous qualitative analyses, and imply that good quantitative estimates may be obtained of the porosity of the uppermost optical layer of the lunar surface. C.T.C.

N66-21035*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MASS-SPECTROMETRIC INVESTIGATION OF REACTION OF OXYGEN ATOMS WITH METHANE
Edgar L. Wong and Andrew E. Potter, Jr. Washington, NASA, Apr. 1966 16 p refs
(NASA-TN-D-3371) CFSTI: HC $0.20/MF $0.50 CSCL 07C

A mass-spectrometric stirred-reactor technique was used to study the reaction of atomic oxygen with methane with low concentrations of molecular oxygen. Low concentrations of molecular oxygen were used to suppress the reactions $O+O_2+M \rightarrow O_3+M$ and $H+O_2 \rightarrow HO_2+M$. An overall rate constant for oxygen-atom disappearance due to added methane was obtained for the temperature range of 375° to 576°K. This rate constant was $4.2\times10^{14}\exp(-10,300/RT)$ and was compared with the previous rate constant for this reaction in the presence of a large excess of molecular oxygen. This comparison showed that the presence of an excess of molecular oxygen increased the oxygen-atom consumption only for the lower temperatures. Product analyses indicated that the stoichiometry of the reaction could be represented by $CH_4+4.09\ O \rightarrow 0.91\ CO+1.00\ O_2+0.95\ H_2+1.00\ H_2O+0.09\ CO_2+0.10H$. On the basis of product analyses, a reaction mechanism was proposed. From this reaction mechanism and the reaction stoichiometry the rate of the initial elementary reaction $CH_4+O \rightarrow CH_3+OH$ was estimated to be about one-fourth of the overall rate for oxygen atom disappearance, or $\sim9\times10^{13}\exp(-10,000/RT)$. Author

N66-21044*# National Aeronautics and Space Administration, Washington, D. C.
CHEMICAL-KINETIC BASIS FOR DIFFERENTIATION OF SECONDARY AND PRIMING EXPLOSIVES [O KHIMIKO-KINETICHESCOY OSNOVE RAZLICHIYA MEZHDU VTORICHNYMI I INITSIIRUYUSHCHIMI VZRYVCHATAMI VESHCHESTVAMI]
K. K. Andreyev and M. S. Plyasunov Apr. 1966 5 p refs Transl. into ENGLISH from Zh. Vses. Khim. Obshch (USSR), v. 8, no. 8, 1963
(NASA-TT-F-418) CFSTI: HC $0.05/MF $0.50 CSCL 07C

The properties which differentiate a primary explosive from a secondary explosive are defined and discussed. The composition of gaseous combustion products of some secondary and primary explosives at atmospheric pressure is provided. It is shown that for secondary explosives, the highest percentage of nitrogen is given off in the form of an oxide; in primary explosives such groups as N_3 may be easily converted to nitrogen at atmospheric pressure. It was recommended that further investigations be made at various degrees of pressure. H.S.W.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-19792# Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA FOR OCTOBER AND NOVEMBER, 1965
1966 38 p *Its* Issue no. 8
CFSTI: HC $2.00/MF $0.50

Tabulations are presented for kinetheodolite observations made at Malta during August, September, and October 1965. Data, presented for satellites launched between 1961 and 1965, include azimuths and elevations for various times. M.W.R.

N66-19802# Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA FOR MAY, 1965
1966 89 p *Its* Issue No. 2
CFSTI: HC $3.00/MF $0.75

Satellite positions recorded at Malta during May 1965 are tabulated. Data are based on kinetheodolite observations for satellites launched between 1962 and 1965. Azimuths and elevations are listed for various times. M.W.R.

N66-19830 Radio Corp. of America, Camden, N. J. Communications Systems Div.
GEMINI SPACECRAFT PCM-FM TELEMETRY TRANSMITTERS
R. J. Erdmann *In its* Space Electron. [1965] p 14-15 ref (See N66-09827 10-31)

The GEMINI two-man spacecraft will use a pulse-code-modulated FM telemetry system operating at bit rates up to 112.6 kilobits. The RCA-designed solid-state three-transmitter system described herein provides the RF telemetry link between the spacecraft and earth. A wide range of modulation frequencies (25 cps to 150 kc) low distortion, compactness, and light weight are design features. Author

N66-19856# Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA FOR FEBRUARY, MARCH AND APRIL 1965
1966 57 p *Its* Issue no. 1
CFSTI: HC $3.00/MF $0.50

Tabulated data are presented on the time, azimuth, and elevation of satellites observed during February, March, and Arpil of 1965 from Malta. These satellites include Sputnik 4, Ariel 1 rocket, Alouette rocket, Star-rad, Injun 3 satellite, Injun 3 rocket, Geophysics Research Satellite, Thor-Agena B, Atlas-Agena B, Polyot 1, Explorer 19, Ariel 2 rocket, Cosmos 42 rocket, Explorer 22, Explorer 24, Cosmos 51 rocket, Cosmos 53 rocket, Cosmos 53 satellite, Cosmos 54 rocket, Agena rocket, and two unidentifiables. R.N.A.

N66-19857# Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA FOR JULY AND AUGUST 1965
1966 44 p *Its* Issue no. 6
CFSTI: HC $2.00/MF $0.50

Tabulated data from kinetheodolite observations of satellites on Malta during July and August of 1965 are presented.

The tables include time, azimuth, and elevation data. The satellites observed include Aeriel 1 rocket, Ariel 1 satellite, Alouette rocket, Star-rad, Injun 3 rocket, Thor Agena D, Geophysics Research Satellite, Thor Agena B, Dash 2, Explorer 19, Nimbus rocket, Explorer 22, Explorer 24, Cosmos 54 rocket, EGRS, Explorer 27, Cosmos 70 satellite, Cosmos 70 rocket, Proton 1 rocket, Cosmos 79 rocket, and 3 unidentifiables. R.N.A.

N66-19858# Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA FOR AUGUST, SEPTEMBER AND OCTOBER 1965
1966 38 p *Its* Issue no. 7
CFSTI: HC $2.00/MF $0.50

Tabulated data from kinetheodolite observations of satellites on Malta during August, September, and October of 1965 are presented. The tables contain time, azimuth, and elevation data. The satellites observed include Midas 4, Alouette rocket, Star-rad, Injun 3 rocket, Agena rocket, Dash 2, Explorer 19, Elecktron 1, Cosmos 44, Explorer 24, Ablestar rocket, Cosmos 56, Cosmos 54 rocket, Cosmos 58 rocket, Thor Altair, Thor Ablestar, Cosmos 70 rocket, Cosmos 71 rocket, and 2 unidentifiables. R.N.A.

N66-19859# Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA FOR MAY, JUNE AND JULY 1965
1966 55 p *Its* Issue no. 3
CFSTI: HC $3.00/MF $0.50

Tabulated data from kinetheodolite observations of satellites on Malta during May, June, and July of 1965 are presented. The tabulated data include time, azimuth, and elevation data. The satellites observed include Samos 2, Ariel 1 rocket, Alouette rocket, Injun 3 rocket, Thor Agena D, Explorer 17, Geophysics Research Satellite, Atlas Agena B, Polyot 1, Explorer 19, Nimbus rocket, Explorer 22, Explorer 24, Cosmos 51, Object 1228, satellites 27A and 27C, Molnija rocket, and several unidentifiables. R.N.A.

N66-19860# Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA FOR JULY 1965
1966 45 p *Its* Issue no. 4
CFSTI: HC $2.00/MF $0.50

Tabulated data from kinetheodolite observations of satellites on Malta during July 1965 are presented. The tables include time, azimuth, and elevation data. The satellites observed include Alouette rocket, Star-rad, Thor Agena D, Geophysics Research Satellite, Thor Agena B, Explorer 19, Nimbus rocket, Explorer 24, Cosmos 54 Rocket, Object 1228, Explorer 27, Satellite 48A, Cosmos 70 satellite, Cosmos 70 rocket, and several unidentifiables. R.N.A.

N66-19867# Radio and Space Research Station, Slough (England).
OPTICAL OBSERVATIONS RECEIVED BY THE PREDICTION SERVICE FOR THE MONTH OF SEPTEMBER 1965
[1965] 38 p
CFSTI: HC $2.00/MF $0.50

Presented are the optical satellite observation data as received by the prediction service during September, 1965. Noted are observing stations, the time of observation, right ascension, degree, and magnitude of emission. G.G.

N66-19868# Radio and Space Research Station, Slough (England).
OPTICAL OBSERVATIONS RECEIVED BY THE PREDICTION SERVICE FOR THE MONTH OF AUGUST, 1965 AND SUPPLEMENTARY OBSERVATIONS FOR THE MONTH OF APRIL, MAY AND JUNE 1965
[1965] 55 p
CFSTI: HC $3.00/MF $0.50

Presented are optical satellite observation data as received by the prediction service during August, 1965, and also supplementary data for the month of April, May, and June, 1965. Noted are observing stations, the time of observation, right ascension, degree, and magnitude of emission. G.G.

N66-19869# Radio and Space Research Station, Slough (England).
OPTICAL OBSERVATIONS RECEIVED BY THE PREDICTION SERVICE FOR THE MONTH OF OCTOBER, 1965
[1963] 47 p
CFSTI: HC $2.00/MF $0.50

Presented are the optical satellite observation data as received by the prediction service during October, 1965. Noted are observing stations, time of observation, right ascension, degree, and magnitude of the emission. G.G.

N66-19891# J. G. Engineering Research Associates, Baltimore, Md.
SOME THOUGHTS ON NEAR FIELD–FAR FIELD NOISE PREDICTION
Joshua E. Greenspon [1964] 4 p refs
(Contract Nonr-5040(00))
(AD-626800) CFSTI: HC $1.00/MF $0.50

For the near field–far field noise problem, relations are outlined for the computation of the far field spectral density from one set of space measurements not necessarily taken at the same time. Equations are derived using a truncated Fourier transform which give the spectral density of the far field pressure at a given point for the truncated random stationary process. For the transient process the complete Fourier transform describes the frequency spectrum of the signal at a given point in space. For single frequency signals the pressure itself satisfies the Helmholtz equations and other near field–far field techniques can be used. The uses of the equations derived from pressure–time records around the sound source for the transient or random stationary processes are described. E.A.O.

N66-19895 Joint Publications Research Service, Washington, D. C.
RADIO TELEMETRY
Hai Hsun *In its* Transl. on Communist China's Sci. and Technol., No. 296 3 Mar. 1966 p 6–10 (See N66-19893 10-34)
CFSTI: $2.00

The advantages of radio telemetry over automatic recording devices in flight testing high speed aircraft are discussed. Using ratio telemetry reduces the aircraft load, records more types of data, makes flight data available even in the case of mishaps, gives immediate test results to ground personnel, and reduces the burden of the test pilot, thereby improving the safety of the test flight. Radio telemetry applications in flight tests of

rockets and guided missiles, pilotless reconnaisance aircraft, military reconnaissance satellites, space research, and in testing ejection seats are mentioned. Telemetry equipment and components are described and their oppratione discussed. The functions of several types of conductors which convert physical signals to electric signals are also described. R.N.A.

N66-19939# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
ELECTRO-TECHNOLOGY—SURVEY OF LITERATURE [ELECTROTECHNIEK LITERATUUROVERZICHT]
21 Jan. 1961 36 p refs In DUTCH, ENGLISH and GERMAN *Its* Vol. 15, No. E-479
CFSTI: HC $2.00/MF $0.50

Abstracts and bibliographic notes are included in the categories of telecommunications, radar, electromagnetic radiation, geometry, information processing, analog computers, computers (hardware and software), computer applications, measurement techniques, regulating techniques, miniaturization, oscillators and magnifiers, components and materials, and technical news. Transl. by J.O.

N66-19957# Illinois State Water Survey, Urbana. Atmospheric Sciences Section.
EVALUATION OF THE MASER-EQUIPPED RADAR SET AN/MPS-34 AND AREA PRECIPITATION MEASUREMENT INDICATOR Quarterly Progress Report, 1 Jul.–30 Sep. 1965
R. E. Rinehart and D. M. A. Jones 29 Oct. 1965 20 p
(Contract DA-28-043-AMC-01257(E))
(QPR-2; AD-625760) CFSTI: HC $1.00/MF $0.50

Difficulties encountered with the Area Precipitation Measurement Indicator (APMI) and progress in overcoming these problems are discussed briefly. The MASER-equipped MPS-34 radar was operated during August near Magdalena, New Mexico, and 49-3/4 hours of data were collected of which 18 hours were on MASER mode. Nearly 700 feet of radar film collected on 19 days of operations are available for analysis. The MASER operation was limited by the occasional lack of helium, and for a short period by trouble with the pump klystron circuits. An addition was made to the elevation control system to provide smoother scanning in the RHI mode and to permit the RHI mode to be photographed through the same indicator system as the PPI mode. Analysis of data collected during August in New Mexico was limited to unusual echoes which appeared as coherent targets up to 42 db below full gain without the MASER operating. The conclusion is that these targets were birds. Author (TAB)

N66-19960# RAND Corp., Santa Monica, Calif.
THE SEARCH FOR A RATIONALE FOR INTERSTELLAR COMMUNICATIONS
Stephen H. Dole Jan. 1966 8 p Presented at the 132nd Ann. Meeting of the Am. Assoc. for the Advan. of Sci., Berkeley, Calif., 30 Dec. 1965
(P-3296; AD-626675) CFSTI: HC $1.00/MF $0.50

The paper explores the motives that have been given, or that might lie behind the expressed desire to communicate with other intelligent life forms living elsewhere in our Galaxy. TAB

N66-19990# Columbia Univ., New York. Dept. of Electrical Engineering.
V-LINE SURFACE WAVE RADIATION AND SCANNING Scientific Report No. 85
Paul Diament, Stephen L. Richter, William L. Lupatkin, and S. Perry Schlesinger 24 Aug. 1965 36 p refs
(Contract AF 19(628)-2461)
(CU-14-65-AF-2461-EE; AFCRL-65-725; AD-626762) CFSTI: HC $2.00/MF $0.50

The feasibility of converting a surface wave propagating structure, the V-line, into an end-fire or broadside radiator is analyzed theoretically and demonstrated experimentally. It is shown that the radiation may be considered, under suitable design and launching conditions, to be associated with a higher-order hybrid mode of propagation of the cylindrical dielectric rod. End-fire radiation induced by axial truncation and broadside radiation from a parasitic linear array are predicted and verified. A radiation scanning situation simulating electrical control of beam position by varying the permittivity of the binding element is illustrated and discussed critically. Author (TAB)

N66-20008# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
AUTOMATIC TRACKING WITH SEQUENTIAL LOBING TECHNICAL MEMORANDUM, DEC. 1962–NOV. 1964
Roy L. Rogers 16 Aug. 1965 51 p refs
(Contract DA-28-043-AMC-00379(E))
(EDL-M904; AD-626089) CFSTI: HC $3.00/MF $0.50

This report analyzes the problem of automatic tracking with a passive RF system by sequential lobing of antenna beams. The analysis is general enough to be applied to optical, infrared, and sonar passive tracking systems. Among the problems considered are (a) processing of tracking-error waveforms, (b) demodulations techniques, (c) antenna-beam gradient and resolution, (d) pulse detection, (e) the lobing rate, and (f) receiver AGC requirements. The conclusion drawn is that the sequential-lobing system, compared to the conical-scan system, is as accurate, has the advantage of a variable lobing rate, and can change antenna beams electronically, but its signal-processing circuitry is more complex. Results of the analysis were applied to the development of wideband (50 to 500 Mc and 1 to 11 Gc) sequential-lobing tracking systems. Author (TAB)

N66-20015# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
SOME EXTREMAL PROPERTIES OF THE DOLPH ARRAY Interim Report
Charles J. Drane, Jr. Nov. 1965 27 p refs *Its* Phys. Sci. Res. Paper No. 165
(AFCRL-65-833; AD-62177) CFSTI: HC $2.00/MF $0.50

Approximate but accurate closed-form representations for directive gain and radiation pattern beamwidth were developed for the classical Dolph-Chebyshev design of an optimum, linear antenna array of uniformly placed isotropic elements. Both directivity and beamwidth are functions of the length of the array, as well as of the particular sidelobe level for a chosen design. This paper contains information regarding the value of the mainlobe–sidelobe ratio required to achieve maximum directivity values for a wide range of array lengths. Corresponding values of maximum directivity are also included. The directivity-beamwidth product is evaluated over a wide range of sidelobe levels and array lengths, and the region over which this product is essentially constant is specified. In the interests of achieving joint minimization of beamwidth and maximization of directivity, the particular value of sidelobe level—such that the directivity-beamwidth ratio is maximized—is determined. The nature of the effect of scanning on these studies is included. Author (TAB)

N66-20030*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

INTERFERENCE FROM SATURN V PROTOTYPE INTERNAL WORK LIGHTS

1 Dec. 1965 28 p

(NASA-TM-X-57254; TR-221) CFSTI: HC $2.00/MF $0.50 CSCL 09F

This report contains an evaluation of Saturn V prototype internal work lamps when tested for broadband radiated and broadband conducted interference. Test configurations, test results, conclusions, and recommendations are included. Author

N66-20097*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

[COMMUNICATION SCIENCES] Semiannual Report, 1 Jul.–31 Dec. 1965

[1963] 54 p refs

(Grant NsG-553)

(NASA-CR-70709) CFSTI: HC $3.00/MF $0.50 CSCL 09D

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N66-20098* Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

NONSUPERVISION AND PARAMETER-CONDITIONAL MIXTURES

J. C. Hancock and E. A. Patrick *In its* [Commun. Sci.] [1965] p 1-6 ref (See N66-20097 10-07) CFSTI: HC $3.00/MF $0.50

Precisely different nonsupervisory problems and the a priori knowledge they utilize are evaluated by first defining mixtures as results of vector partitioning into $\pi_1, \pi_2, \ldots, \pi_W$ ways. A mixture $X = X_s = |X_{s_k}|_1^v$ with single pattern class activity does not grow with increasing v because the statistically dependent samples are supervised. The a priori knowledge to construct this mixture is knowledge of M, the family, and the fact that $X_s = |X_{s_k}|_1^v$ has one pattern class activity for all samples. This type of mixture arises when applying the histogram concept to nonsupervisory problems. Brief examples for $X = X_s$ with interclass interference, for two possible sets of mixing parameters, and for a given set of possible mixture families are given. G.G.

N66-20099* Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

COGNITIVE SIGNAL PROCESSING

J. C. Hancock and W. D. Gregg *In its* [Commun. Sci.] [1965] p 7–12 refs (See N66-20097 10-07) CFSTI: HC $3.00/MF $0.50

This summary report on unsupervised signal pattern recognition studies contains a computer simulation of a noisy signal pattern format subjected to a separation test that demonstrated quite reliable results for signal to noise ratios down to −4.5 db. The a priori mode of its time series analog consisted of vector separation into two classes on the basis of statistical similarity and combination to provide a priori estimates of the class parameters. Also developed was an asymptotic form of the Bayes decision boundary from unsupervised or unclassified vector samples. The effects of no preclassification or supervision for signal to noise ratios less than 0 db appear as bias in the asymptotic error probability and are two to four times greater than those of the known Bayes matched filter. G.G.

N66-20100* Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

ADAPTIVE DETECTION WITHOUT SYNCHRONIZATION

J. C. Hancock and T. L. Stewart *In its* [Commun. Sci.] [1965] p 13-18 refs (See N66-20097 10-07) CFSTI: HC $3.00/MF $0.50

A receiver structure for detecting deterministic signals in gaussian noise and simultaneously adapts to unknown signal parameters and unknown synchronizations was studied through an iterative approach. A model diagram for the system is shown. Its transmitter selects one of a finite set of waveshapes every T seconds, the channel alters the transmitted waveshape in such a way that noise is added, and the resultant signal is presented to the receiver for decision which of the M possible signals to send. The solution is optimum and provides a means of synchronization for the conventional detection problem without using any additional synchronization signals. G.G.

N66-20102* Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

PURDUE CHANNEL SIMULATOR

P. A. Wintz and R. A. Markley *In its* [Commun. Sci.] [1965] p 24–25 (See N66-20097 10-07) CFSTI: HC $3.00/MF $0.50

Described is a water tank simulator of randomly time-varying communication channels that posesses various adjustable parameters for fitting channel characteristics to different demands. Hydrophones are used to connect the transmitter and receiver with the channel. Effective scaling of path lengths, antenna beam widths, etc. to the velocity of electromagnetic radiation in free space ratio with the velocity of sound in water can be utilized to scale kilometers to centimeters and transducers of a few centimeters diameter can produce beam widths of a few degrees at megacycle frequencies. G.G.

N66-20103* Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

EXPERIMENTAL RESEARCH ON COMMUNICATION SYSTEMS SUBJECT TO INTERSYMBOL INTERFERENCE

J. C. Lindenlaub and C. C. Bailey *In its* [Commun. Sci.] [1965] p 26-28 (See N66-20097 10-07) CFSTI: HC $3.00/MF $0.50

Two binary communication model systems are described that allow the determination of error performance probability

for a wide range of channel distortion filters and modulation schemes of varying signal-to-noise ratios. The digital computer simulation model passes signal computations through the system with frequency domain specifications by using magnitude and phase functions associated with the signal's Fourier transform. The laboratory communications model was built with transistorized electronic circuitry and operates with unipolar AM square pulse modulation. Its error detector makes logical comparisons between the output signal of a pseudo-random sequence generator and the output of the decision device, and produces two sets of pulses for input to the counter; one set indicates false alarm errors and the other indicates false dismissal errors. G.G.

N66-20104* Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
OPTIMUM WAVEFORMS AND RECEIVERS FOR CHANNELS WITH MEMORY
J. C. Hancock and E. A. Quincy *In its* [Commun. Sci.] [1965] p 29-38 refs (See N66-20097 10-07) CFSTI: HC $3.00/MF $0.50

Joint optimization of transmitted pulse waveforms and the receiver when the channel response is time-invariant and known was studied for binary communications systems. It was presumed that the channel exhibited sufficient memory so that intersymbolic interference resulted at the receiver. The probability of error was denoted by formula:

$$P_e(s_1,s_2,E,\rho)=\int_R f(u)du$$

where the resultant functional P_e depended on the signal parameters: energies E, and all possible cross-correlations ρ of the two desired signal waveforms. By numerically integrating and by plotting a family of curves, the effects of the pertinent signal parameters on P_e were analyzed. G.G.

N66-20105* Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
SIGNAL SELECTION FOR TELEMETRY CHANNELS
R. E. Totty *In its* [Commun. Sci.] [1965] p 37-41 refs (See N66-20097 10-07) CFSTI: HC $3.00/MF $0.50.

Telemetry waveform transmission in such a fashion that the received waveform is a scaled replica of the origin was analyzed for three sources of error. Considered were the initial approximation error denoted by ϵ_a^2, which is the error incurred by describing the waveform by a finite number of samples; the quantization error denoted by ϵ_q^2, which incurred by quantizing the samples; and the error due to incorrect decisions made at the receiver, which was a channel error and is denoted by ϵ_e^2. Several conditions under which equation

$$\epsilon^2=\epsilon_a^2+\epsilon_q^2+\epsilon_e^2$$

is valid for particular error criteria are presented. G.G.

N66-20145*# New Mexico State Univ., University Park. Physical Science Lab.
THE DESIGN OF A BROADBAND ROTATING FEED FOR A LOW NOISE TEMPERATURE ANTENNA WITH AUTO-TRACK CAPABILITY
H. W. Haas Jun. 1963 132 p refs
(Contract NAS10-48)
(NASA-CR-71193) CFSTI: HC $4.00/MF $1.00 CSCL 09F

The design of a broadband rotating feed for a 19-foot parabolic reflector antenna which offers a low noise temperature auto-track capability is presented. The electrical and mechanical parameters, the antenna types considered for the primary feed, the primary feed tests in the reflector, noise temperature calculations, and the mechanical construction of the antenna are described. R.N.A.

N66-20150# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DIGITAL FILTER DESIGN TECHNIQUES
Charles M. Rader and Bernard Gold 23 Dec. 1965 71 p refs
Its Tech. Note 1965-63
(Contract AF 19(628)-5167)
(ESD-TDR-65-593; AD-627146) CFSTI: HC $3.00/MF $0.75

Digital filtering is the process of spectrum shaping using digital components as the basic elements. Increasing speed and decreasing size and cost of digital components make it likely that digital filtering, already used extensively in the computer simulation of analog filters, will perform, in real-time devices, the functions which are now performed almost exclusively by analog components. In this paper, using the Z-transform calculus, several digital filter design techniques are reviewed, and new ones are presented. One technique can be used to design a digital filter whose impulse response is like that of a given analog filter; another technique is suitable for the design of a digital filter meeting frequency response criteria. A third technique yields digital filters with linear phase, specified frequency response, and controlled impulse response duration. The effect of digital arithmetic on the behavior of digital filters is also considered. Author (TAB)

N66-20196 Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
EVALUATION OF ATCBI-3 TRANSMITTER MODIFICATIONS AND OMNI ANTENNA Final Report
Robert W. Delaney Nov. 1965 100 p
(RD-65-127)

The report describes modifications designed to introduce sidelobe suppression (SLS) features, improve the selection and interlacing of interrogation modes, add beacon sync trigger and mode trigger output capability, and provide the transmitter with additional pulse power capacity. Emphasis was given to comparison of the design requirements with the actual levels of interrogation pulse and SLS pulse power measured during instrumented flights within a representative beacon environment. It was concluded that the design requirements for the prototype modifications are generally valid as a basis for product specifications but must be refined so as to limit the attentuation of SLS pulses within the SLS crystal diode switch. It was also concluded that the modification for additional transmitter power is not required. It was recommended that the transmitter pulse power amplifier be omitted from the standard modification but that provisions be made for adjustment of the ratio of interrogation pulse power to SLS pulse power, over a 3 dB range, when the modifications are installed in the field.
Author

N66-20197# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
EVALUATION OF SLATE III MARK I Final Report
Robert A. Waldmann Nov. 1965 33 p refs
(RD-65-135)

An evaluation of a small lightweight altitude transmission equipment, SLATE III Mark I was conducted to determine its suitability for operation in present and proposed air traffic

control environments. Flight tests were conducted in the advanced radar traffic control system environment and the stored program alpha-numeric system environment. In addition, a short series of bench tests were conducted. It was concluded that the SLATE III Mark I is suitable for operation in present and proposed air traffic control environments. It was recommended the Federal Aviation Agency promote, within the general aviation community, the use of radar beacon transponders having capabilities similar to the SLATE III Mark I. Author

N66-20198# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

EXPERIMENTAL TESTING OF THE IMPROVED 3-PULSE INTERROGATION SIDE LOBE SUPPRESSION SYSTEM Final Report

George F. Spingler Nov. 1965 52 p ref
(RD-65-139)

The improved 3-pulse SLS system was designed to increase the signal level of the first interrogation pulse received by an aircraft transponder and thereby minimize transponder replies to interrogations from reflections. A method of transmitting the interrogation pulse from the radar beacon system omnidirectional and directional antenna was developed. The proper interrogation pulse level required to be radiated from the omnidirectional antenna to obtain proper suppression of reflected replies was determined by tests. In addition, the adaptability of the modified air traffic control beacon interrogation transmitter to the improved system was also analyzed and a field trial of the system was accomplished. It was concluded that the improved 3-pulse SLS system is effective in reducing the quantity of transponder replies to interrogations resulting from reflections and is suitable for application in the air traffic control radar beacon system. Author

N66-20568# Lincoln Lab., Mass. Inst. of Tech., Lexington.

12-HORN MONOPULSE ANTENNA SYSTEM FOR MILLSTONE HILL RADAR

Charles A. Lindberg 15 Jun. 1965 38 p refs *Its* Tech. Rept.-393
(Contract AF 19(628)-500)
(ESD-TDR-65-238; AD-627008) CFSTI: HC $2.00/MF $0.50

The 440-Mcps conical-scan tracker at the Millstone Hill radar site has been converted to an L-band 12-horn monopulse tracker utilizing a Cassegrain optics reflector system. The amplitude sensing monopulse feed illuminates a 10-foot subreflector and thence an 84-foot-diameter paraboloid with linear or either sense of circular polarization. This system conversion increased the capabilities of the radar complex in that higher antenna gain and increased tracking sensitivity are obtained. The merits of the 12-horn system have been proven with actual results substantiating the theoretical predictions. This report discusses the design considerations and final performance characteristics of the overall antenna system and its individual components. Author (TAB)

N66-21586# Illinois Univ., Urbana. Radiolocation Research Lab.

MISMATCH CORRECTION TECHNIQUES FOR TWIN-CHANNEL RECEIVERS Technical Report No. 12

John J. Henderson Aug. 1965 49 p refs
(Contracts NObsr-89229; Nonr-1834(02))
(RRL-282; AD-625826)

Reported is a study to determine the bearing errors resulting from the inherent differences in two identical receivers used in a radio direction finding system. A digital computer program simulating the magnitude of, and techniques for eliminating this bearing error is provided. Receiver mismatch, which results from a number of gain and phase differences, were simulated for various azimuthal angles of arrival as well as for one case of wave interference. A method was devised so that the error still in evidence after correction could be compared to the original error. A test signal method was also studied to determine whether further improvements in bearing error reduction could be obtained. Test results are illustrated graphically and it was concluded that the test signal method offered a means for decreasing errors to a very small value. H.S.W.

N66-20620 Joint Publications Research Service, Washington, D. C.

OPTIMAL DETECTION OF SOME NON-GAUSSIAN SIGNALS IN NOISE

Yu. G. Sosulin *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 142-155 refs (See N66-20606 10-10) CFSTI: $6.00

The equations for optimal reception of a markov process in noise are made specific for the case of a multidimensional markov process. Using approximate methods optimal receivers are synthesized for detection of non-gaussian signals with fluctuating phase and amplitude. A comparison is made of the quality of the operation of the optimal and nonoptimal receivers for the detection of signals with fluctuating phase. Author

N66-20621 Joint Publications Research Service, Washington, D. C.

SEPARATION OF SIGNALS FROM NOISE WITH LOSS FUNCTIONS WHICH DEPEND ON THE TIME OF OBSERVATION OF THE SIGNALS

Yu. F. Achkasov and A. I. Yablonskiy *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 156–172 refs (See N66-20606 10-10) CFSTI: $6.00

The problem of separation of a random number of signals with unknown parameters observed during a limited time against a background of noise, is solved. The optimal decision rules are obtained by minimization of the average risk. The loss functions consider the errors in the determination of the parameters, the observation time for the signals, the possibility of skipping signals and false alarm, and also the cost of processing the data. The simplified decision rules are presented, and it is shown that use of them does not lead to large losses by comparison with the losses using the optimal methods. Author

N66-20622 Joint Publications Research Service, Washington, D. C.

OPTIMAL FILTRATION OF A SIGNAL OF GIVEN FORM AGAINST A BACKGROUND OF NONSTATIONARY RANDOM NOISE

S. P. Dmitryiyev, G. V. Dolgintseva, and A. A. Ignatov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 173–183 refs (See N66-20606 10-10) CFSTI: $6.00

The application of the method of solution of a problem on optimal filtration is described as follows in work [1] for a case where the useful signal is itself a function of a given form. The solution of the problem is given for biased and unbiased estimates of the useful signal. It is shown that when using the method of work [1] the cases which are called special in work [2] do not occur. Author

N66-20623 Joint Publications Research Service, Washington, D. C.

ON THE CORRECTNESS OF THE STATEMENT OF PROBLEMS IN THE THEORY OF APPROXIMATION OF RANDOM FUNCTIONS

G. V. Rossikhin and V. B. Breyman *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 184-199 refs (See N66-20606 10-10)
CFSTI: $6.00

It is shown that the known procedure for determination of the optimal operator with respect to the criterion of minimum least square error in a number of cases leads to an unlimited operator, and the statement of the problem of approximation of random functions in this form may be mathematically incorrect. The minimax criterion of optimalness is formulated taking into account the possible discrepancies between the actual and the approximate statistical characteristics of the random functions included in the calculation. The problem of determination of the optimal operator with respect to the generalized criterion formulated is always correct. Author

N66-20705# Rome Univ. (Italy). Center of Aerospace Research.

THE INCREASE IN THE PRECISION OF ANALOG TRANSMISSION DATA [L'AUMENTO DELLA PRECISIONE NELLA TRASMISSIONE ANALOGICA DEI DATI]

Giorgio Ravelli Jun. 1964 36 p refs In ITALIAN; ENGLISH summary
CFSTI: HC $2.00/MF $0.50

In this report are studied some systems for improving the accuracy of the analog data transmission. As it is difficult to increase the accuracy obtainable with the standard analog telemetry systems by improving the performance of the transmission and reception circuits, such accuracy can be increased by one or more orders of magnitude by means of suitable converters on the output signal of the transducers. Hence the study describes the operation principles, the characteristics and the limits of some conversion systems, and includes expressions to regulate some particular electronic circuits of these systems. Finally, it reports the results attained with circuits made in the laboratory. Author

N66-20706# Illinois Univ., Urbana. Radiolocation Research Lab.

AN INVESTIGATION OF A DIGITAL BEARING COMPUTER FOR A SMALL APERATURE RADIO DIRECTION FINDING SYSTEM Technical Report No. 27

Hubert L. Grush June 1965 119 p refs
(Contract Nonr-1834(02))
(RRL-280; AD-623177) CFSTI: HC $4.00/MF $0.75

A small aperture radio direction finding system such as a Watson-Watt system is subject to large bearing errors because of the wave interference effect of two waves. By contrast, a large aperture system such as a Wullenweber system exhibits smaller errors under corresponding conditions. This work attempts to develop a practicable means of obtaining accurate bearing information using a small aperture system in the presence of strong wave interference. The technique used is the time averaging of instantaneous bearings. Thus, bearing information may be obtained with a small aperture system by using information available over an extended period of time. The computation of the bearing may be carried out on-line by a small general purpose digital computer. One of the unique features of the digital bearing computer developed here is its capability to adapt to changing input signal conditions. The adaptive capability makes it possible to optimize the averaging process. The process allows estimates of the indicated bearings of both the primary and the interfering waves and their relative strengths to be made. A mathematical model for the relative phase between the two waves is evolved which is not unlike that of the real phase function. The model yields a regular progression of phase plus a random perturbing component. The only restriction placed upon the phase function is that its probability density function be essentially uniform. Author (TAB)

N66-20725 RAND Corp., Santa Monica, Calif.

STUDIES IN INTER-SENTENCE CONNECTION

Kenneth E. Harper Dec. 1965 21 p refs
(Contract AF 44(638)-1700; Proj. RAND)
(RM-4828-PR; AD-626572) CFSTI: HC $1.00/MF $0.50

A systematic analysis of portions of the Russian physics text processed at RAND, to determine the extent of repetition in adjacent sentences. Recurrence of words in all pairs of contiguous sentences in the text (2467 pairs) was recorded in a machine printout; sentence pairs for which word recurrence was not automatically recorded were visually inspected for other types of recurrence (through lexical stems, pronouns, synonyms, and paraphrases). The extent of the different types of recurrence is reported, and features of the recurring items are discussed. Sentence pairs characterized by nonrecurrence (12 percent of the total) are examined, and the relevance of inter-sentence recurrence and nonrecurrence to automatic syntactic analysis and abstracting is suggested. Author (TAB)

N66-20842# Melpar, Inc., Falls Church, Va.

INVESTIGATION OF SPEECH PROCESSING STUDIES Scientific Report No. 1, Feb. 1964-Sep. 1965

H. A. Straight, O. C. King, and K. H. Shingler Oct. 1965 68 p refs
(Contract AF 19(628)-4032)
(AFCRL-65-847; AD-626807) CFSTI: HC $3.00/MF $0.75

The report contains the results of an investigation using a digital Voice Data Processor (AD-286 097, AD-286 158). The system is a special-purpose data processor designed to support research on digital voice communications and, in particular, the evaluation of a speech bandwidth compression technique. Although the continuing investigation has provided support to the research effort, it has more pertinently styled the growth of the data processor as a research tool. The most significant modification to the system has been the incorporation of two digital magnetic tape units as additional input/output equipments. Other changes which have been made include the capability of compiling rank-ordered data in tables of specified values for pattern frequency; the tabulating the frequency distribution of pattern deviation values; and, the tabulation of the number of missed pattern matches in a specific number of voice samples. These changes have significantly expanded the capability and flexibility of the processor and also greatly decreased the general processing time required. With the increase in capability has gone a comparable increase in programming requirements by the operator; the revised System Operating Instructions are included as Appendix A. Author (TAB)

N66-20926# Radio and Space Research Station, Slough (England).

[OBSERVATIONS MADE DURING JANUARY, FEBRUARY AND MARCH, 1964]

CFSTI: HC $3.00/MF $0.50

Tabular data are presented on satellite observations by cinetheodolite of Epsilon 3, Iota 1, Omicron 1, Alpha-Delta 1, Kappa 1, Beta-Alpha 1 and 2, Beta-Mu 2, Beta-Psi 1, and Beta-Tau 6. Cinetheodolite film reading observations are also included. M.G.J.

N66-21030*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPUTER PROGRAM TO EVALUATE THE EFFECTIVENESS OF PCM FRAME SYNCHRONIZATION STRATEGIES
Bernard G. Narrow and Morton Pasternack Washington, NASA, Mar. 1966 25 p
(NASA-TN-D-3338) CFSTI: HC $0.40/MF $0.50 CSCL 09F

This paper describes a computer program which simulates the PCM (Pulse Code Modulation) conversion equipment, and through the Monte Carlo technique measures the effectiveness of a given strategy for the equipment control settings for a given satellite. Rather than testing all possible 24,576 strategies, a manual elimination method is described for reducing the number of strategies to be tested to a feasible number. In addition to evaluating strategies for the conversion process, the program can be used to evaluate proposed modifications to the conversion equipment presently in use, and can also aid in determining the size of the frame identifier for the telemetry systems of future PCM satellites. Author

N66-21078*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PRELIMINARY DESIGN, VOLUME A (BOOK 2 OF 4): FLIGHT SPACECRAFT PREFERRED DESIGN—TELECOMMUNICATIONS
30 Jul. 1965 572 p refs Prepared for JPL *Its* Rept.-65SD4388
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71486) CFSTI: HC $8.72/MF $2.75 CSCL 17B

The preferred design for the 1971 Voyager Flight Spacecraft telecommunication system is discussed. The system level functional requirements are described for the telecommunication, spacecraft radio, flight command, relay radio, data handling and storage, and data storage subsystems. Also described is the data encoder. The description of the telecommunication subsystem includes the ground and spacecraft functions required for tracking, telemetering, and commanding of the spacecraft by the deep space network. Table and graphs of data and performance characteristics of the subsystems are included. L.S.

N66-21083*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PRELIMINARY DESIGN, VOLUME B (BOOK 2 OF 3): ALTERNATE DESIGNS CONSIDERED—TELECOMMUNICATIONS
30 Jul. 1965 469 p refs Prepared for JPL *Its* Rept.-65SD4388
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71491) CFSTI: HC $7.69/MF $2.25 CSCL 09F

Trade-off studies between the various systems comprising the telecommunications system, and between the telecommunications system and other spacecraft systems and the mission operated system of the Voyager Spacecraft are described. Trade-offs internal to the radio, and command subsystems; and between the spacecraft relay radio subsystem and other system parameters are considered. In addition, data handling and storage requirements and design concepts as influenced by the mission sequence; the alternate designs and trade-offs of the data encoder; and the data storage system configuration are given. L.S.

N66-21100*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRIME MINITRACK AND BAKER-NUNN OF SATELLITE 1959 α_1 (VANGUARD II)
Hans G. Hertz Washington, NASA, Mar. 1966 45 p refs
(NASA-TM-X-1201) CFSTI: HC $0.65/MF $0.50 CSCL 17I

Concurrent data necessary for making a comparison study of the accuracies of Prime Minitrack and Baker-Nunn observations of Satellite 1959 α_1 (Vanguard II) are presented in this report. In all, 244 Prime Minitrack and 187 Baker-Nunn observations are available which were made over a 26-day period while the satellite's transmitter was operating. Prime Minitrack observations were possibly only during transmitter operation. Data included here are comprised of Prime Minitrack and Baker-Nunn observations made concurrently. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-19822# Hawaii Univ., Honolulu. Dept. of Electrical Engineering.
SOME RESULTS ON CAPABILITIES OF ONE-DIMENSIONAL ITERATIVE LOGICAL NETWORKS AND THEIR RELATED PROBLEMS Scientific Report No. 4
Tadao Kasami 1 Aug. 1965 24 p refs
(Contract AF 19(628)-4379)
(AFCRL-65-602; AD-626733) CFSTI: HC $1.00/MF $0.50

Results on capabilities of one-dimensional systems of iterative logical networks are presented. It is shown that (1) Kilmer's result (AD-425 943) implies a positive answer to Hennie's conjecture ('Iterative arrays of logical circuits,' MIT Press, Cambridge, Mass. 1961) that the unilateral systems which are stable in the wide sense are more powerful than the strictly stable unilateral systems, (2) the unilateral systems which are stable in the wide sense are more powerful than the nondeterministic push-down automata, (3) the strictly stable unilateral systems are more powerful than the deterministic push-down automata and (4) a proper subclass of strictly stable unilateral systems is more powerful in a sense than the class of two-tape one-way automata. It also is proved that (1) a language generated by a linear grammar is n squared-recognizable by a single-tape Turing machine in the sense of Hartmanis and Stearns ('Computational complexity of recursive sequences.' Proc. Fifth Annual Symposium of Switching Circuit Theory and Logical Design', (Oct. 1964) p. 82-90) and (2) there is a language which is generated by a linear grammar and is not n-recognizable. Author (TAB)

N66-19843 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
COMPUTER-CONTROLLED AUTOMATIC TESTING—A REVIEW
Bradford T. Joyce and Eugene M. Stockton *In its* Space Electron. (1965) p 68-71 ref (See N66-19827 10-31)

The digital computer has assumed a very active and powerful role in controlling automatic test equipment. It has become a vital component of the test system because of its inherent abilities for high-speed calculation, large-capacity memory, and programmed decision-making—abilities that enable the test system to isolate faults to a level normally attainable only by skilled test personnel. The computer provides the test designer with a flexibility that eases the planning of test procedures and reduces the size of the total test program. It readily accommodates mathematical diagnostic techniques as they are perfected and opens the door to simplifications in the stimulus and measurement equipment that it controls. This

paper reviews the philosophy of computer-controlled automatic testing, and presents specific cases of the powerful role that the computer plays and will play therein. Author

N66-19907# Hawaii Univ., Honolulu. Dept. of Electrical Engineering.
AN EFFICIENT RECOGNITION AND SYNTAX-ANALYSIS ALGORISM FOR CONTEXT-FREE LANGUAGES Scientific Report no. 2
Tadao Kasami 11 Jul. 1965 40 p refs
(Contract AF 19(628)-4379)
(AFCRL-65-558; AD-626731) CFSTI: HC $2.00/MF $0.50

An efficient algorithm of recognition and syntax-analysis for the full class of context-free languages without the difficulty of exponential growth of computing time with the length n of input sequence is presented. This algorithm makes use of the essential property of a context-free language as a multi-parenthesis system. It is shown in this paper than a context-free language is n^3-recognizable in the sense of Hartmanis and Stearns ('Computational complexity of recursive sequences'. Proc. Fifth Annual Symposium of Switching Circuit Theory and Logical Design (Oct. 1964) p. 82-90) by a double-tape or double-head single-tape Turing machine and it is n^4-recognizable by a single-head single-tape Turing machine. If we use a random-access memory whose size is proportional to n^3, the computing time required for syntax analysis is upperbounded by $C_1n^3+C_2n^2N$, where N denotes the number of nonequivalent valid derivation sequences for a given input sequence and C_1's are constants independents of input sequences. If we use a tape of length C_3n^3 and one of length C_4n^2 as working memories, the computing time for syntax-analysis is upperbounded by $C_5n^3(1+N)$. The size of required memory can be reduced to the order of n^2, but the computing time rises to the order of n^4. Author (TAB)

N66-19916# Rochester Univ., N. Y. Inst. of Optics.
OPTICAL LENS SYSTEMS DESIGN FORMULAE FOR HIGH SPEED COMPUTERS Quarterly Status Report
Robert E. Hopkins 30 Dec. 1965 22 p
(Contract DA-30-069-AMC-534(A))
(QSR-7; AD-626844) CFSTI: HC $1.00/MF $0.50

The following areas of work are to be covered: (1) Improve and extend the optical design features in ORDEALS, (2) study the effects of glass choice, with particular emphasis on secondary color, (3) study three and four element objectives in order to pin point regions of solution, and (4) refine a program which makes drawings of optical components as viewed from any desired vantage point. Image error groups are studied in order to determine a standard set of image errors which will be useful for general design. In the appendix of this report is a copy of the FLAIR program with its input format. Author (TAB)

N66-19922# Wisconsin Univ., Madison.
A DISCRETE PREDICTOR CONTROLLER APPLIED TO SINUSOIDAL PERTURBATION ADAPTIVE OPTIMIZATION
George E. P. Box, R. J. Altpeter, and K. D. Kotnour (Minn. Mining and Mfg. Co.) Nov. 1965 29 p refs
(TR-58; AD-626856) CFSTI: HC $2.00/MF $0.50

Uncontrollable and unmeasurable disturbances possessing nonstationary characteristics often create major control problems in chemical processes. Typical of these fluctuations are composition changes in a homogeneous system and catalyst activity changes in a heterogeneous system. In this report, Box and Jenkins' theory of discrete predictive control is mechanized on an analog computer and applied to sinusoidal perturbation adaptive optimization of a natural gas combustion system. Process dynamics and the stochastic characteristics of disturbances are programmed into the discrete predictor controller to provide an adaptive control system which allows for process upsets before they occur. Statistically designed experiments are constructed to evaluate the performance. An outline of the theory and a description of the equipment is presented. Results show that the insertion of the discrete predictor controller into the adaptive control loop provides significant improvement over the conventional proportional feedback of sinusoidal adaptive optimization. Author (TAB)

N66-20044# Joint Publications Research Service, Washington, D. C.
GENERAL DESCRIPTION OF THE SOVIET SPACE CO-ORDINATION COMPUTER CENTER
Am. Trifonov 21 Feb. 1966 12 p Transl. into ENGLISH from Pravda (Moscow), 3 Jan. 1966 p 4
(JPRS-34222; TT-66-30663) CFSTI: $1.00

The operation of the coordination computer center in tracking active satellites was reviewed. Factors determining length of active existence of satellites were discussed, such as power engineering, orbit, weight, and shape. Some details of the flight control system and the telemetry system and its operation were given. Abnormalities in the sending and receiving of signals were mentioned. N.E.N.

N66-20074# European Atomic Energy Community, Brussels (Belgium).
THE COMPILATION AND PROCESSING OF IBM 1401 PROGRAMS ON IBM 7090. VOLUME IV: FLOW CHARTS OF THE COMPILER AND OF THE SIMULATOR
A. F. R. Brown Jan. 1966 111 p
(EUR-2637.e, Vol. 4) CFSTI: HC $4.00/MF $0.75

Flow charts are presented for an IBM 1401 compiler to be used on the IBM 7090. The compiler is designed to generate 1401 magnetic tape input and output routines. Also included are charts for the simulation of 1401 operations on the 7090. D.T.

N66-20169# Illinois Univ., Urbana. Coordinated Science Lab.
A DECODING METHOD FOR BOSE-CHAUDHURI BINARY CODES USING AN ERROR COUNTING TECHNIQUE
W. Jack Bouknight Oct. 1965 34 p refs
(Contract DA-28-043-AMC-00073(E); Grant NSF GK-36)
(R-267; AD-623525) CFSTI: HC $2.00/MF $0.50

The implementation of a decoding scheme for Bose-Chaudhuri (n,K) cyclic codes is discussed. A method of error counting is formulated and a trial-and-error correction operation is developed based on error count reduction by successful trial corrections. Author (TAB)

N66-20222# California Univ., Livermore. Lawrence Radiation Lab.
FORMULA MANIPULATION CODE FOR THE CALCULATION OF CHRISTOFFEL SYMBOLS
John J. Walton 5 May 1965 41 p
(Contract W-7405-ENG-48)
(UCRL-14177) CFSTI: HC $2.00/MF $0.50

The IBM FORMAC compiler was used to write a program capable of calculating various quantities of interest in tensor calculus. With this code Christoffel symbols of the first and second kind were calculated for 12 basic orthogonal coordinate systems. Author (NSA)

N66-20226# Oak Ridge National Lab., Tenn. Neutron Physics Div.

A GENERALIZED ONE-CONSTRAINT LAGRANGE MULTIPLIER NUMERICAL FORMULATION

F. H. S. Clark and F. B. K. Kam Jun. 1965 46 p

(Contract W-7405-ENG-26)

(ORNL-3742, Rev.) CFSTI: HC $3.00/MF $0.50

The one-constraint Lagrange multiplier problem was written for the CDC-1604 computer in a FORTRAN program called MAX. The program can deal with a combination of any varied and any constraining function which depends on no more than 18 independent variables and for which all second derivatives exist throughout the domain. The user is required to write two sub-routines: one defines the varied function, the other, the constraining function. The computational method used is absolutely nondivergent, but for some starting values in some problems it will stop in the neighborhood of an extraneous point and require a restart at a different point. A test problem is included. Author (NSA)

N66-20238# Sandia Corp., Albuquerque, N. Mex.

AUTOMATED PLOTTING OF FLOW CHARTS ON A SMALL COMPUTER

H. E. Anderson Jan. 1965 69 p refs

(Contract AT(29-1)-789)

(SC-TM-64-1784) CFSTI: HC $3.00/MF $0.75

A computer program is described which accepts Fortran II source programs as input data and which produces annotated flow charts as output. The program is unique in that a digital incremental plotter is used as the output medium, and the fact that the program is designed for a small (40,000 digits storage) computer. Author (NSA)

N66-20239# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

THE DATAPOOL CONCEPT. A DATAPOOL SIMULATION SUBROUTINE

J. A. Warrington and E. E. Kazmierczak 22 Mar. 1965 17 p Presented at the Transac Users Group Meeting, San Antonio, Tex.

(Contract W-31-109-ENG-52)

(CONF-650408-1) CFSTI: HC $1.00/MF $0.50

The design of a file management scheme for computer tapes is described. The scheme (called DATAPOOL) is in use at KAPL. The DATAPOOL concept is described, and a program that implements the DATAPOOL concept is shown. NSA

N66-20292# Gosudurstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).

STATUS AND MEANS FOR DEVELOPMENT OF MULTICHANNEL ANALYZERS [SOVREMENNOE SOSTOYANIE I PUTI RAZVITIYA MNOGOKANAL'NYKH ANALIZATOROV]

I. S. Krasheninnikov 1964 23 p refs In RUSSIAN *Its* Rept.-79

(NP-15258)

The state of the art is reviewed for multichannel analyzers (MA) having 50 to 100, 200 to 500, and 1000 to 100,000 channels. Various transistorized circuits such as a triggering scheme, and various time and amplitude converters are briefly described. The characteristics of ferrite core memories are given. Data are given on six multichannel analyzers of Russian origin with 50, 100, 128, 256, and 2048 channels. The counting time varied from 16 to 1000 μsec. The integral nonlinearity was 0.5 to 2%. The maximum initial count rate was 5000 to 50,000 counts/sec. Most of the counters had ferrite core memories. The units had one or more of the following features: automatic correction for dead time, typewriter readout, automatic plotter, magnetic tape recorder, or oscilloscope display. The errors due to scale shift and the amplitude converters could be eliminated to improve the operation of the analyzers. NSA

N66-20341# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Elektronik-Institut.

EXPRESS METHOD FOR ELECTRONIC PULSE COUNTERS [AUSDRUCKVERFAHREN FUR ELECTRONISCHE IMPULSZAHLER]

W. Attwenger and K. Petreczek Mar. 1965 21 p refs In GERMAN; ENGLISH Summary Submitted for Publication

(SGAE-E-4/1965)

For automatic measurements in nuclear research, scalers with printout units are used. An electronic circuit is described, which allows the print-out of collected data from one or more scalers. The printer is a common adding machine. Author (NSA)

N66-20378# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.

A STUDY OF THREE ANALOG-TO-DIGITAL CONVERSION TECHNIQUES Scientific Report No. 17

K. K. Reedy 15 Dec. 1964 97 p refs Prepared for Oak Ridge Natl. Lab.

(Contract W-7405-ENG-26)

(TID-21938) CFSTI: HC $3.00/MF $0.75

The theory of analog-to-digital conversion processes is considered. Three of the most commonly used conversion techniques are discussed and compared. These techniques are the ramp, the cascaded-stages, and the successive-approximation methods. Emphasis is placed on the speed and accuracy of each conversion technique. Ramp conversion is accomplished by performing an intermediate conversion of a pulse height to a time interval and then converting the time interval to a digital number. The analysis of the ramp method illustrates the inherent speed limitation of this technique while emphasizing that the ramp method is capable of producing an extremely accurate digital output with a minimum of circuit complexity. Cascaded-stages conversion uses a weighing or comparison procedure to form the digital representation of an analog number. Each bit of the digital output is formed by a successive comparison of the input signal to a reference voltage weighted in value according to the position in the digital output of its correspondence bit. Since the conversion time of the cascaded-stages method depends primarily on the sum of the settling times of each of its individual stages, this technique has the shortest conversion time of the three methods discussed. The successive-approximation conversion process essentially consists of a step-by-step buildup of a feedback reference voltage by a trial-and-error procedure that involves the generation of a digital output, decoding of the digital output and comparison of the decoded output with the input signal, and alteration of the output until it agrees with the input signal. Of the three methods discussed, the successive-approximation technique represents the best compromise among speed of response, conversion accuracy, and circuit complexity. Comparison of the three coding techniques was achieved by considering several system applications grouped according to their speed and accuracy requirements and indicating which of the conversion techniques could best meet the performance specifications imposed by the system application. Author (NSA)

N66-20381# Sandia Corp., Albuquerque, N. Mex.
THE RECONSTRUCTION OF AN ANALOG SIGNAL FROM NONUNIFORMLY SPACED SAMPLES
G. H. Honnold Feb. 1965 36 p refs
(Contract AT(29-1)-789)
(SC-TM-65-3) CFSTI: HC $2.00/MF $0.50

The instrumentation of long-duration signals can lead to a desire to reduce the number of samples required for signal representation. The number of samples resulting from a sampling operation can be reduced by making either the sampling scheme itself or some process subsequent to a fixed-frequency sampling of the signal dependent upon some characteristic of the signal. In general, the samples which result from such sampling processes will be nonuniformly spaced in time. The nature of these sampling schemes is discussed, as are several techniques for the reconstruction of an analog signal from a set of nonuniformly spaced samples. The results do not lead to generalizations about the choice of sampling and reconstruction schemes, but some insight into the problems involved and the nature of the sampling and reconstruction processes are provided. Author (NSA)

N66-20410# California Univ., Livermore. Lawrence Radiation Lab.
COMPUTERS IN THE U.S.A.—TODAY AND TOMORROW
S. Fernbach 4 Jan. 1965 25 p refs Presented at 1965 Meeting of the IFIP Congr., New York, 24–29 May 1965
(Contract W-7405-ENG-48)
(UCRL-12294-T) CFSTI: HC $1.00/MF $0.50

Digital computers have proliferated in the country over the past 15 years, such that at present there are many thousands of them, large and small, totaling approximately 4 billion dollars in value. The small ones of today are far more capable and less expensive than the large ones of yesterday. One of the problems facing computer users is that of choice of equipment for future use. With the speed of the new systems so great that most problems consume very little time, the user has to decide whether he should put his money in one very large, capable machine or into a large number of smaller computers dealing with these problems in a parallel mode. If a parallel processor is the machine of the future, it is not clear at present how one writes systems for it, or how one distributes the work for it. Much effort will be necessary to determine how such computers, hardware, and software, should be built and used efficiently. Author

N66-20414# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
CAVIAR—CAROLINAS VIRGINIA ANALYSIS AND DATA REDUCTION CODE
Raymond J. Nath Mar. 1965 162 p refs
(Contract AT(30-1)-2289)
(CVNA-223) CFSTI: HC $5.00/MF $1.25

A detailed explanation of the mathematics and procedures used in the CAVIAR code is given, along with the method of inputting quantities to the code in order to analyze flux wire data from the Carolinas Virginia Tube Reactor. Author

N66-20424# European Organization for Nuclear Research, Geneva (Switzerland).
A DATA LINK FROM PS EXPERIMENTAL AREA TO MERCURY COMPUTERS
F. Marciano and H. J. Slettenhaar 4 Feb. 1965 27 p refs
(CERN-65-5)

The linkages and operations involved in the use of a Mercury computer on-line with the CERN proton synchrotron are reviewed. The operating characteristics of the computer are described, with reference to its use in conjunction with a missing-mass spectrometer. T.F.H.

N66-20458# United Kingdom Atomic Energy Authority, Harwell (England). Applied Mathematics Group.
PROPOSED SPECIFICATIONS OF A COMPUTING SYSTEM USING REMOTE CONSOLES: HUW
I. C. Pyle Aug. 1965 19 p
(AERE-M-1627) HMSO: 3s

HUW (Harwell Users' Workshop) is essentially a file maintenance and message switching system in which a number of users at remote terminals can have access to a number of programs being executed concurrently by a central computer. Standard programs would exist for use from any terminal, some of which would allow the user to originate new programs to be executed either immediately or later. Bulk storage would be available for keeping files of information (data or programs), which may be accessed by programs in the computer. Author (NSA)

N66-20536# California Univ., Livermore. Lawrence Radiation Lab.
PROGRAM OPTIMIZING TECHNIQUES FOR THE CDC 6600 CENTRAL PROCESSOR
Harry L. Nelson 6 Apr. 1965 57 p
(Contract W-7405-ENG-48)
(UCRL-12489) CFSTI: HC $3.00/MF $0.75

General information is given on the CDC 6600 central processor, after which rules for and examples of optimum coding for the CDC 6600 are presented. The technique of timing analysis is introduced and demonstrated, and the problem of optimization of the inner loop is considered. NSA

N66-20538# Oak Ridge National Lab., Tenn. Chemistry Div.
ORTEP: A FORTRAN THERMAL-ELLIPSOID PLOT PROGRAM FOR CRYSTAL STRUCTURE ILLUSTRATIONS
Carroll K. Johnson Jun. 1965 128 p refs
(Contract W-7405-ENG-26)
(ORNL-3794) CFSTI: HC $4.00/MF $1.00

A computer program is described for drawing crystal structure illustrations with a mechanical plotter. Ball-and-stick type illustrations of a quality suitable for publication are produced with either spheres or thermal-motion probability ellipsoids on the atomic sites. The program can produce stereoscopic pairs of illustrations which aid in the visualization of complex packing arrangements of atoms and thermal motion patterns. Interatomic distances, bond angles, and principal axes of thermal motion are also calculated to aid the structural study. The FORTRAN coding utilizes the comparable features of IBM 709/7090 FORTRAN II and CDC 1604/1604A FORTRAN 63 so that the program can be executed on a number of different machines which have 32 K word memories. The machine-oriented plotting subroutines are standard library-type routines with slight modifications. Both CalComp and Benson Lehner off-line magnetic-tape plotting systems have been used successfully. Sample stereo-figure illustrations and a viewer are included. Author (NSA)

N66-20561# California Univ., Berkeley. Lawrence Radiation Lab.
THE USE OF A LARGE PHOTODIGITAL MASS STORE FOR BUBBLE CHAMBER ANALYSIS

Margaret H. Alston and Samuel J. Penny May 1965 11 p Presented at the Purdue Conf. on Instrumentation for High Energy Phys., Lafayette, Ind.
(Contract W-7405-ENG-48)
(UCRL-11999; CONF-650510-2) CFSTI: HC $1.00/MF $0.50

The purchase of a photodigital store with a capacity of about 3.3×10^{11} bits is planned. This store, which is a read only memory, will be connected online to the CDC-6600 computer and will serve as a repository for many types of information. The data in the store can be accessed directly by programs running in the central computer or by priority requests initiated at online consoles. A proposed system for the data manipulation and retrieval required to handle the analysis of over one million bubble chamber events per year is presented. Author (NSA)

N66-20596# Texas Univ., Austin. Electrical Engineering Research Lab.
AN ANALYSIS OF DYNAMIC POWER SPECTRA
W. E. Sims and F. X. Bostick, Jr. Washington, ONR, 31 Dec. 1965 82 p refs
(Contract Nonr-375(14))
(Rept.-134; AD-627022) CFSTI: HC $3.00/MF $0.75

A digital computer program has been developed for computing and displaying dynamic or running power density spectra, with the results being presented as contour plots having lines of constant spectral density on time-frequency planes. The program is discussed in detail, and samples of the output are included. Author (TAB)

N66-20607 Joint Publications Research Service, Washington, D. C.
A PROBLEM IN INTEGRAL CONVEX PROGRAMMING
V. F. Dem'yanov and L. Yu. Khudyakov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 1-18 ref (See N66-20606 10-10) CFSTI: $6.00

An integral problem in convex programming is investigated [See Note]. First the corresponding nonintegral (continuous) problem is studied, a method for sequential approximations of its solution is proposed and it is shown how by the known solution of a continuous problem one finds the solution of a natural problem. For a number of problems the proposed method if effective; however, for certain problems it may lead to an extraordinarily large selection. Author

N66-20615 Joint Publications Research Service, Washington, D. C.
ON A RECOGNITION ALGORITHM
Yu. K. Orlov and Yu. S. Natkovich *In its* News of the Akad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 87-95 ref (See N66-20606 10-10) CFSTI: $6.00

A recognition algorithm of a statistical nature is described. Limitations are introduced on the class of problems solved. The algorithm consists of three parts: the preliminary gathering of standard descriptions of the classes, recognition itself and subsequent correction of the standard descriptions. The last step is carried out only in the case of sufficiently accurate identification. Results are presented from the experiment in simulation using the Ural-2 digital computer. Author

N66-20616 Joint Publications Research Service, Washington, D. C.
ANALYSIS AND SOME PROBLEMS IN OPTIMIZATION OF THE STRUCTURE OF AN ASYNCHRONOUS DIGITAL COMPUTER WITH SIMULTANEOUS OPERATIONS
Ye. K. Degtyarev *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 96-112 refs (See N66-20606 10-10) CFSTI: $6.00

An algorithm for planning the fulfillment of a finite series of commands on asynchronous digital computer (ADC) is proposed if the commands consist of operations of known length which belong to a finite set of operations, and each operation may be fulfilled on a unique circuit from a finite set of circuits making up the ADC. As a result of application of the algorithm to a series of commands a linear graph is constructed with the vertex of the functions the critical path of which equals the time of fulfillment of the series of commands. A theorem is proved about the applicability of the algorithm. Author

N66-20617 Joint Publications Research Service, Washington, D. C.
ON THE PROBLEM OF SPECIFYING FINITE AUTOMATA AND SEQUENTIAL MACHINES
V. M. Ozernoy *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 113-117 refs (See N66-20606 10-10) CFSTI: $6.00

The assignment of sequential machines is investigated using simple transition matrices and conversion vectors permitting formulation of the algorithm for reproduction of an output series in the form of an analytical expression with respect to a given fundamental table of the series machine and the given input series. An example is presented which illustrates the use of the algorithm obtained. Author

N66-20618 Joint Publications Research Service, Washington, D. C.
PROBABILITY SIMULATION OF THE OPERATIONS OF MULTIPLICATION AND RAISING TO A POWER FOR NONSTOCHASTIC MATRICES
B. M. Boychenko and V. S. Gladkiy *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 118-126 ref (See N66-20606 10-10) CFSTI: $6.00

The procedures for multiplication and raising to a power with respect to matrices with real elements are investigated. The operations indicated are carried out by similar simulation of random automata with absorption states after reducing the matrices to equivalent stochastic matrices. Author

N66-20619 Joint Publications Research Service, Washington, D. C.
ARITHMETIC DIVISIBLE CODES WITH CORRECTION OF INDEPENDENT ERRORS
Yu. G. Dadayev *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 127-141 refs (See N66-20606 10-10) CFSTI: $6.00

A new class of arithmetic divisible codes is proposed with correction of independent errors. The limitations on the selection of the generating modules are discussed along with a procedure for determining the length of the code: for the modules $p_1, p_2 < 64$ (no more than 12 control positions) codes are presented with minimum redundancy. The difficulties of encoding are investigated, better codes are presented in the sense of simplicity of encoding with correction of single errors. The algorithm for decoding is illustrated in some examples. Author

N66-20637# Research Analysis Corp., McLean, Va.
APPLICATION OF CHANCE-CONSTRAINED PROGRAMMING TO SOLUTION OF THE SO-CALLED "SAVINGS AND LOAN ASSOCIATION" TYPE OF PROBLEM

Abraham Charnes (Northwestern Univ.) and Michael J. L. Kirby
Oct. 1965 24 p refs
(Contract Nonr-1228(10))
(RAC-P-12; AD-625050) CFSTI: HC $1.00/MF $0.50

This paper contains an application of chance-constrained programming to a problem in financial planning. In particular the problem is one of planning for liquidity in a savings and loan association first discussed by Charnes and Thore. The optimal rules for this problem are found and compared with the optimal linear rules given by Charnes and Thore. The discontinuous nature of the optimal rules is discussed from economic and control theory viewpoints. Author (TAB)

N66-20680# Parke Mathematical Labs., Inc., Carlisle, Mass.
SOME BINARY CODES FOR ERROR-CORRECTION AND SYNCHRONIZATION Scientific Report No. 4
Eric Myrvaagnes Oct. 1965 32 p refs *Its* Rept.-3826-SR-4
(Contract AF 19(628)-3826)
(AFCRL-65-887; AD-627029) CFSTI: HC $2.00/MF $0.50

A number of variable-length binary codes are listed, with information about their capabilities for error correction and synchronization. Author (TAB)

N66-20683# Parke Mathematical Labs., Inc., Carlisle, Mass.
BASIC PROPERTIES OF ERROR-CORRECTING CODES Scientific Report No. 6
Lorenzo Calabi and Lester K. Arguette Nov. 1965 38 p refs *Its* Rept.-3826-SR-6
(Contract AF 19(638)-3826)
(AFCRL-65-888; AD-627030) CFSTI: HC $2.00/MF $0.50

Properties normally considered peculiar either to block codes for noisy channels or else to variable length codes for noiseless channels are defined in a uniform manner. Among the basic notions are those of correcting ability, decodability and synchronizability; all are formulated for variable length codes over arbitrary alphabets for noisy channels. Theorems establish all the logical implications which exist between the properties considered; examples illustrate their differences.
Author (TAB)

N66-20687# Atomic Energy Establishment, Winfrith (England). Reactor Group.
EDITOR: A PROGRAMME FOR EDITING BCD DATA ON MAGNETIC TAPE IN THE FORMAT OF THE U.K.A.E.A. NUCLEAR DATA LIBRARY
A. L. Pope May 1965 19 p refs
(AEEW-M-553) HMSO: 2s 6d

This paper describes the program EDITOR and gives operating instructions. EDITOR is written in the S2 Fortran dialect for the IBM 7030 computer. Its purpose is to prepare data library tapes for the U.K.A.E.A. nuclear data library by copying prescribed data files in BCD from one or more input data tapes, or from card decks, on to a single output tape.
Author

N66-20713# Carnegie Inst. of Tech., Pittsburgh, Pa. Graduate School of Industrial Administration.
THEORY AND APPLICATION OF AN INFERENCE MODEL FOR NON-STATIONARY TIME SERIES MEANS Final Report
Melvin Hinich and John U. Farley Dec. 1964 25 p refs
(Contract Nonr-760(24))
(MSRR-27; AD-613369) CFSTI: HC $1.00/MF $0.50

Complex time series models, such as consumer brand shifting analyses, have required assumptions of parameter stability because statistical models to deal with parameter change were not available. A model is developed here to make inferences about a possibly nonstationary time series mean generating data with Gaussian error. Estimators which are efficient in a special sense are presented, along with examples and suggested applications of the method to brand switching problems. Author (TAB)

N66-20718# RAND Corp., Santa Monica, Calif.
JOSS: SCENARIO OF A FILMED REPORT
C. L. Baker Jun. 1964 54 p ref
(Contract AF 49(638)-700; Proj. RAND)
(RM-4162-PR; AD-602074) CFSTI: HC $1.25/MF $0.50

Report on a film and discussion of the Rand Johnniac Open-Shop System, an on-line time shared application of the Rand Johnniac Computer. TAB

N66-20720# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF PIERCING THE SELECTING MATRIX OF A MEMORY
A. K. Kultygin 15 Nov. 1965 4 p Transl. into ENGLISH from Soviet Patent no. 167367 (Appl. no. 844975/26-24, 2 Jul. 1963) 2 p
(FTD-TT-65-995/1+2+4; AD-625288) CFSTI: HC $1.00/MF $0.50

Object of the invention: A method of piercing the selecting matrix of the memory device with linear selection designed on ferrite cores with a rectangular hysteresis loop with the uniting of the energy of a great number of sources which has the distinguishing feature that for the purpose of decreasing the length of the piercing wires, as well as the number of wires which penetrate each core, the selecting matrix is broken down into a number of blocks of lesser capacity, the piercing of the blocks is accomplished in accordance with a code, the number of bits of which depends on the capacity of the block, and the corresponding coordinates of the winding of the neighboring (in accordance with the coordinates x and y) blocks are connected in sequence. Author (TAB)

N66-20816# Colorado Univ., Boulder. Dept. of Psychology.
DISSEMINATION RESEARCH Final Report, Jul. 1964–Jul. 1965
Peter G. Ossorio Griffiss AFB, N. Y., RADC, Dec. 1965 85 p refs
(Contract AF 30(602)-3432)
(RADC-TR-65-314; AD-625905) CFSTI: HC $3.00/MF $0.75

A description is given of the initiation of an operational dissemination system based on the Classification Space methodology developed previously, (AD-608 034). A set of three evaluational studies, now in progress, is described. A report is made of the empirical results of three semantic studies designed to form the basis for complementing the Classification Space by providing a capability for indexing and dissemination in terms of the conceptual content of documents or other textual units. Recommendations for the further development of the dissemination system and for the further application of pragmatic methodology in linguistic data processing are made
Author (TAB)

N66-20843# Hawaii Univ., Honolulu. Dept. of Electrical Engineering.
ON THE WEIGHT STRUCTURE AND SYMMETRY OF BCH CODES Scientific Report No. 1

W. Wesley Peterson 10 Jul. 1965 30 p refs
(Contract AF 19(628)-4379)
(AFCRL-65-515; AD-626730) CFSTI: HC $2.00/MF $0.50

Weight distributions found by digital computation are given for a number of Bose-Chaudhuri-Hocquenghem codes of length 2^m-1 for m as large as ten. The minimum weight was determined in some additional cases which include all non-trivial double, triple, and quadruple error correcting codes by theoretical results and by computer search. In each known case, the true minimum weight meets the Bose-Chaudhuri-Hocquenghem lower bound. It was observed that $ja_j=(n+1-j)a_{n+1-j}$ for all BCH codes for which weights were computed, where n is the code length and a_j the number of code words of weight j. It is shown that a BCH code extended by the addition of an overall parity check is invariant under permutations of the doubly-transitive affine group, and the observed equation holds as a consequence of this symmetry.

Author (TAB)

N66-20875*# Massachusetts Inst. of Tech., Cambridge, Mass. Research Lab. of Electronics.

CONCATENATED CODES Technical Report 440

G. David Forney, Jr. (Ph.D. Thesis) 1 Dec. 1965 116 p refs
(Grants NsG-334; NsG-496; Contract DA-36-039-AMC-03200(E); Grants NSF GP-2495; NIH G-MH-04737-05)
(NASA-CR-71160) CFSTI: HC $4.00/MF $0.75 CSCL 09D

We present theoretical and computational results bearing on the efficiency and complexity of concatenated codes; the major theoretical results are the following: (1) Concentration of an arbitrarily large number of codes can yeild a probability of error that decreases exponentially with the over-all block length, while the decoding complexity increases only algebraically; and (2) Concentration of a finite number of codes yields an error exponent that is inferior to that attainable with a single stage, but is nonzero at all rates below capacity. Computations support these theoretical results, and also give insight into the relationship between modulation and coding. This approach illuminates the special power and usefulness of the class of Reed-Solomon codes. We give an original presentation of their structure and properties, from which we derive the properties of all BCH codes; we determine their weight distribution, and consider in detail the implementation of their decoding algorithm, which we have extended to correct both erasures and errors and have otherwise improved. We show that on a particularly suitable channel, RS codes can achieve the performance specified by the coding theorem. Finally, we present a generalization of the use of erasures in minimum-distance decoding, and discuss the appropriate decoding techniques, which constitute an interesting hybrid between decoding and detection.

Author

N66-20907# Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

THE IBM 7040 SYSTEM. PART I: GENERAL CONCEPTS OF DIGITAL COMPUTATION. [IL SISTEMA IBM 7040. PARTE I: CONCETTI GENERALI SULL'ELABORAZIONE ELETTRONICA DEI DATI]

G. Carloni, G. Farchi, and D. Giucci 10 May 1965 73 p In ITALIAN; ENGLISH summary
(ISS-65/15) CFSTI: HC $3.00/MF $0.75

This set of reports is intended to explain the computing methods for the IBM 7040 system. The present report contains an introduction to the general concepts of digital computation; it also deals with the description of data recording instruments and the data representation in the core storage of the computer.

Author

N66-20908# Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

THE IBM 7040 SYSTEM. PART II: THE SYMBOLIC PROGRAMMING LANGUAGE, FORTRAN IV, ISSUE 2 [IL SISTEMA IBM 7040. PARTE II: IL LINGUAGGIO DI PROGRAMMAZIONE FORTRAN IV, FASCICOLO 2]

G. Carloni, G. Farchi, and D. Giucci 10 May 1965 74 p In ITALIAN, ENGLISH summary
(ISS-65/17) CFSTI: HC $3.00/MF $0.75

This set of reports is intended to explain the computing methods for the IBM 7040. The present report describes the symbolic programming language FORTRAN IV.

Author

N66-20986*# TRW Systems, Redondo Beach, Calif.

ONE-DIMENSIONAL REACTING GAS NONEQUILIBRIUM PERFORMANCE PROGRAM Interim Analysis Report

J. R. Kliegel 17 Sep. 1965 130 p refs
(Contract NAS9-4358)
(NASA-CR-65224; TRW-5435-6004-RU-000) CFSTI: HC $4.00/MF $1.00 CSCL 09B

A computer program is described which calculates the inviscid one-dimensional nonequilibrium nozzle expansion of propellant exhaust mixtures containing the six elements: carbon, hydrogen, oxygen, nitrogen, fluorine, and chlorine. The program considers 18 significant gaseous species present in the exhaust mixtures containing these elements, and the 39 chemical reactions (12 dissociation-recombination reactions and 27 binary exchange reactions) which can occur between the exhaust products. A derivation of the equations governing the inviscid one-dimensional flow of a chemically reacting gas mixture is given in the form in which they are integrated in the computer program. A brief discussion is presented of the use of both implicit and explicit integration methods to integrate relaxation equations, and a complete derivation of the second order implicit integration method used in the program. A detailed engineering description is included for all the calculations performed in the computer program. C.T.C.

N66-20998*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

A GENERAL COMPUTER PROGRAM FOR THE DETERMINATION OF RADIANT-INTERCHANGE CONFIGURATION AND FORM FACTORS: CONFAC I

K. A. Toups Oct. 1965 190 p refs
(Contract NAS9-4133)
(NASA-CR-65256; SID-65-1043-1) CFSTI: HC $5.00/MF $1.25 CSCL 09B

A simple numerical method is derived for the determination of the geometric radiant-interchange factors used in radiant heat transfer and illumination. A Fortran IV digital computer program utilizing this method is developed which provides a rapid and accurate means of computation of configuration and form factors. The source of flux may be any general plane polygon, and the receiver may be any general plane or nonplanar polygon. Form factors are computed rapidly—averaging less than two seconds on the IBM 7094 for simple plane surfaces. Simplicity of data entry, flexibility of application, and economy of operation are principal features of this program. Sample problems illustrating these important aspects are provided.

Author

N66-20999*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

A GENERAL COMPUTER PROGRAM FOR THE DETERMINATION OF RADIANT-INTERCHANGE CONFIGURATION AND FORM FACTORS: CONFAC II

K. A. Toups Oct. 1965 364 p refs
(Contract NAS9-4133)
(NASA-CR-65257; SID-65-1043-2) CFSTI: HC $7.00/MF $2.00 CSCL 09B

A simple numerical method is derived for the determination of the geometric radiant-interchange factors used in radiant heat transfer and illumination. A Fortran IV digital computer program utilizing this method is developed which provides a rapid and accurate means of computation of configuration and form factors. The source of flux may be any general plane polygon, and the receiver may be any general plane or nonplanar polygon, the surface of an arbitrary polyhedron, or an arbitrary combination of such surfaces. It is therefore possible to accurately determine configuration and form factors from a plane surface to another surface occluded by complex intervening surfaces. Form factors are computed rapidly—averaging less than two seconds on the IBM 7094 for simple, unobstructed plane surfaces, and less than 30 seconds for simple polyhedra. Also, means are provided to internally generate a variety of regular polygons or polyhedra and to transform surface spatial coordinates for convenience of data entry and/or motion simulation. Simplicity of data entry, flexibility of application, and economy of operation are principal features of this program. Sample problems illustrating these important aspects are provided. Author

N66-21003*# International Business Machines Corp., Owego, N. Y. Federal Systems Div.
AES-EPO STUDY PROGRAM, VOLUME I Final Study Report
31 Dec. 1965 43 p
(Contract NAS9-4570)
(NASA-CR-65253; IBM-65-562-011) CFSTI: HC $2.00/MF $0.50 CSCL 09B

A conceptual study was made to investigate possible solutions to long-term and time-critical reliability problems as they affect the Apollo command module guidance and control computer and its applications to AES missions. Specifically, the Saturn V triple modular redundant computer and a redundant version of the Apollo backup data adapter were investigated as a means of solving the time-critical reliability problem. A detailed investigation of inflight maintenance or module and channel switching of the computer and data adapter were investigated as a means of solving the long-term reliability problem. Packaging; reliability; fault detection and isolation; inflight maintenance in high humidity, zero gravity environments; optimum sparing level; module and channel switching; and other pertinent items were studied in an attempt to determine the required redesign of the subject computer and data adapter subsystem to enable it to meet the functional requirements and reliability apportionment of a typical 90 day AES-EPO mission. Limited fabrication demonstrating an approach to sparing in a high humidity, zero gravity environment was also required. C.T.C.

N66-21004*# International Business Machines Corp., Owego, N. Y. Federal Systems Div.
AES-EPO STUDY PROGRAM, VOLUME II Final Study Report
31 Dec. 1965 235 p
(Contract NAS9-4570)
(NASA-CR-65254; IBM-65-562-012) CFSTI: HC $6.00/MF $1.25 CSCL 09B

Detailed technical descriptions are presented of various investigations that were made of possible solutions to long-term and time-critical reliability problems as they affect the Apollo command module guidance and control computer in its application to the AES mission. The packaging scheme of the Saturn V computer and Apollo backup data adapter was examined to determine its applicability to inflight maintenance, sparing, and module and channel switching in the high humidity, zero gravity environment. The machine organization was examined to determine its applicability to the critical phases of the mission as well as its applicability to inflight maintenance during noncritical phases of the mission. The required organization was determined to allow efficient error detection and failure isolation for inflight maintenance in an AES-EPO mission. Limited fabrication was required to prove the feasibility of inflight maintenance in a high humidity, zero gravity environment. Exploratory evaluation tests were performed on nine representative modules in special test chambers to determine by what margin the modules meet operational requirements. C.T.C.

N66-21005*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USE OF ANALOG COMPUTATION IN PREDICTING DYNAMIC TEMPERATURE EXCURSIONS OF ORBITING SPACECRAFT
Frank J. Cepollina Mar. 1966 42 p refs
(NASA-TM-X-55432; X-430-66-81) CFSTI: HC $2.00/MF $0.50 CSCL 09B

Presented herein is an analog computer program capable of predicting orbiting spacecraft's external surface temperatures. By dividing a spacecraft's external surface into sections and applying transient heat transfer and thermodynamic equations to the boundaries of each section an analog circuit describing total incident energy as a function of spacecraft orbital position is written. The source of external incident energy simulated can be from any combination of solar radiation, earth albedo, earth thermal emission, solar paddle emission, and reflection. The sources of internal energy incident to the inner surfaces can be from instrument power dissipation, and radiation interchange between adjacent and opposite surfaces. Using the AOSO proposed spacecraft as the thermal model, the analog computer solution is shown for the parameters involved. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-19847# North American Aviation, Inc., Los Angeles, Calif.
AN AIRBORNE DATA ACQUISITION SYSTEM FOR USE IN FLIGHT TESTING THE XB-70 AIRPLANE
E. L. Edwards [1965] 27 p Presented at the 26th Meeting, AGARD Flight Mech. Panel, Paris, 9–10 Jun. 1965
(NA-65-434)

The data acquisition and data reduction systems used in flight testing the XB-70 aircraft are described. The overall instrumentation system performs the functions of airborne data acquisition, ground data processing, and preflight checkout. The airborne complex, and in particular its digital section, is the main subject of this discussion. Also included are

a list of the system requirements, block diagrams of the analog and digital recording systems and the instrumentation environmental control equipment, a summary of the digital system characteristics, photographs of equipment and components, and graphical data on environmental temperatures and secondary power and fuel temperatures. R.N.A.

N66-19903# ARINC Research Corp., Annapolis, Md.
MAINTAINABILITY PREDICTION BY UNIT FUNCTION Interim Report, Nov. 1964–Oct. 1965
Harold S. Balaban Griffiss AFB, N. Y., RADC, Dec. 1965 74 p refs *Its* Rept.-317-02-1-534
(Contract AF 30(602)-3387)
(RADC-TR-65-467; AD-626991) CFSTI: HC $3.00/MF $0.75

This report presents the results of a study to determine the feasibility of a maintainability prediction-by-function technique. Shop repair-time data representing over 4500 shop maintenance actions on 78 different line replaceable units, categorized into 25 different function types, were collected at Bunker Hill Air Force Base, Indiana. For selected function types, possible maintainability prediction parameters, such as type of maintenance, depth of maintenance penetration, weight, and volume, that would be available during the early design stage were quantified. The relationship between these parameters and observed mean repair times was analyzed through a multiple regression approach. A set of fourteen prediction equations with factors for obtaining confidence limits were obtained. Although these equations have limited applicability because of the restricted sample, the relatively high observed correlations and generally encouraging results of a verification task indicate the feasibility of developing such maintainability prediction-by-function techniques. Author (TAB)

N66-19906# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF GAMMA RAYS Co_{60} ON f. e. u. PARAMETERS
A. N. Pertsev, A. N. Pisarevskiy, and L. D. Soshin 9 Dec. 1965 13 p refs Transl. into ENGLISH from Pribory i Tekhn Eksperim. (Moscow), no. 2, 1965, p 146-149
(FTD-TT-65-1139/1+2+4; AD-625157) CFSTI: HC $1.00/MF $0.50

The effect on subsequent operation of photomultipliers irradiated with Co^{60} gamma rays is discussed. It is shown that reverse sensitivity changes take place in the photocathode and in the amplification coefficient of the photomultiplier. Author (TAB)

N66-19913# Microwave Associates, Inc., Burlington, Mass.
HIGH POWER SEMICONDUCTOR TR DEVICES Final Report, Jul. 1963–31 Jul. 1965
R. H. Brunton, III [1965] 218 p refs
(Contract DA-36-039-AMC-03187(E))
(Rept.-8; AD-626637) CFSTI: HC $6.00/MF $1.25

This is the final report on the development of high power Semiconductor K_U Band Limiters and X_L Band Switching Devices. The reports presents the program objectives, technical background, theoretical and experimental results and final characteristics of each device. The development effort included both microwave circuit design and semiconductor engineering. Specific efforts were directed toward manufacturing limiter diodes applicable for use at K_U band. Investigation included the use of packageless semiconductors as well as special miniature diode ceramic packages. Microwave circuits were designed and utilized in order to make full use of the semiconductor diodes characteristics. The results of the program in each area of investigation are discussed and experimental data is given. Final conclusions and recommendations for future engineering development to achieve improvements are presented as a result of the successful accomplishments on this contract. Author (TAB)

N66-19928*# Westinghouse Electric Corp., Baltimore, Md. Solid State Technology Lab.
METAL-OXIDE SEMICONDUCTOR STABILITY STUDIES: CAPACITANCE-VOLTAGE MEASUREMENTS Final Report
[1965] 55 p refs *Its* Rept.-5376A
(Contract NAS5-3758)
(NASA-CR-71030) CFSTI: HC $3.00/MF $0.50 CSCL 09A

A major objective was to establish a comprehensive technique for the determination of the metal oxide semiconductor (MOS) device properties significant in a study of instability. A consideration of metal-oxide semiconductor theory determined that the voltage-dependent capacitance curves associated with these structures provide information about their electrophysical properties and can be used for detecting and analyzing instability. Two different but complementary approaches were developed for monitoring these capacitance-voltage curves. A capacitor-admittance technique establishes the quality of the device and reveals those characteristics determined by the properties of the oxide layer. A frequency-determination technique provides data suitable for analytical study and for interpretation of the various design parameters. Equipment was established for both techniques, and data was compiled for a set of three p-channel units. Instability was effectively monitored by this method. Author

N66-20025# Varian Associates, Palo Alto, Calif.
STUDY OF A 100-WATT Ku-BAND TRAVELING WAVE TUBE Quarterly Report No. 1, 1 Jul.–30 Sep. 1965
S. Paul Otsuka Oct. 1965 22 p refs *Its* Rept. 1
(Contract DA-28-043-AMC-01514(E))
(ECOM-01514-1; AD-626219) CFSTI: HC $1.00/MF $0.50

The preliminary electrical design was completed except for the helix to waveguide transitions. The PPM focusing stack was designed, fabricated and measured. A beam tester was constructed, exhausted, cathode-processed and made ready for test. Studies of efficiency improvement were made using a velocity taper for the helix slow wave structure. Author (TAB)

N66-20027*# Matrix Research and Development Corp., Nashua, N. H.
DESIGN AND DEVELOPMENT OF A NON-DISSIPATIVE CHARGE CONTROLLER USING A ROTARY TRANSFORMER First Quarterly Report, 17 Jul.–17 Oct. 1965
[1965] 53 p refs
(Contract NAS5-9204)
(NASA-CR-70932; M2139P800) CFSTI: HC $3.00/MF $0.50 CSCL 09C

Calculations were made and design study was begun for the electrical and mechanical components, including the drive unit, of a rotary transformer to be used with a solar panel power source. Size, configuration and electrical efficiency were the areas investigated. Both square wave and sine wave shapes were evaluated along with two and four transistor configurations for the drive unit, the former requiring a center tap in the transformer primary. It is pointed out that the highest voltage permissible with a center tap is 40V. On the other hand, the four transistor bridge type inverter can tolerate 50V. Despite the fact that the current in the four transistor configuration must traverse two transistors in series, loss figures

for combination of transformer design and voltage choice put the two systems on equitable footing. A transformer excitation unit was considered where the out-of-phase magnetizing current could flow freely between the power source and the transformer. The configuration results in high efficiency and low heat generation. Also considered was the case where the transformer is tuned to operate on sine waves. This mode was found to be as efficient as square wave operation, and also eliminated spiking during the transistor commutation intervals. D.T.

N66-20107# Naval Ammunition Depot, Crane, Ind.
INFORMATION ON MICROELECTRONICS FOR NAVY EQUIPMENTS
1 Dec. 1965 55 p refs *Its* μ-Notes No. 15
(NAD-65-905; AD-627259) CFSTI: HC $3.00/MF $0.50

Contents: Microelectronic Power supply program, resume of integrated circuit thermal study, epitaxial studies (Part VI), evaluation of westinghouse oscillator-mixer, evaluation of fairchild monostable multivibrator, evaluation of fairchild dual comparator, compilation of semiconductor integrated circuits evaluated to date. TAB

N66-20115# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A CHEMICAL REACTION PRODUCES A MICROCIRCUIT
V. Syrkin 15 Dec. 1965 14 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 10, 1964 p 28-31
(FTD-TT-65-1165/1+2+4; AD-625277) CFSTI: HC $1.00/MF $0.50

The report discusses the microminiaturization of circuits using films obtained from carbonyls of metals. TAB

N66-20120# Microwave Associates, Inc., Burlington, Mass.
HIGH POWER FERRITE GAS DUPLEXER Quarterly Progress Report, 11 Jun.-Sep. 10, 1965
Fred A. Jellison [1965] 12 p
(Contract NObsr-91203)
(QPR-5; AD-625765) CFSTI: HC $1.00/MF $0.50

Analysis of the test results on the second YIG-D prototype duplexer indicate that the failure is due neither to nonlinear behavior with peak power nor defective epoxy bonding, but to limitations in the thermal transfer properties of the YIG-D material. Further effort to reduce the length of the final duplexer design using YIG-D material are fruitless and should concentrate on optimizing the design of the previously successful TT2-113 model. Author (TAB)

N66-20138*# Martin Co., Orlando, Fla.
INFRARED TESTING OF ELECTRONIC COMPONENTS, PHASE I, 5 APRIL-29 JUNE 1965
W. R. Randle Jun. 1965 70 p refs
(Contract NAS8-20131)
(NASA-CR-71013; OR-6610) CFSTI: HC $3.00/MF $0.75
CSCL 09A

An industry and government questionnaire survey, technical report evaluations, and personal interveiws revealed active interest in infrared test techniques for electronics. At least 32 industrial organizations are using or investigating infrared techniques along with numerous government agencies. Much of the work is in the area of feasibility studies with emphasis on design evaluation applications, especially in the areas of design packaging (industry) and failure analysis (government). Much remains to be accomplished before infrared techniques become realistic for test purposes, but this study has proved that they will become powerful tools for testing. Author

N66-20139*# Martin Co., Orlando, Fla.
INFRARED TESTING OF ELECTRONIC COMPONENTS, PHASE II, 8 JULY 1965-14 JANUARY 1966
G. Chadderdon and T. Hartman Jan. 1966 69 p ref
(Contract NAS8-20131)
(NASA-CR-71014; OR-8031) CFSTI: HC $3.00/MF $0.75
CSCL 09A

Twenty-five materials were initially screened for their use as a high emissivity, transparent conformal coating for electronic components. On the basis of initial screening tests, the ten most promising materials were selected for more intensive testing. The ten coatings were subjected to five liquid and 13 cured coating tests to determine physical and electrical properties and effect of various environments. With the exception of several weaknesses in areas of adhesion, water absorption, elevated temperature electrical properties, and outgassing, all ten coatings performed satisfactorily and were ranked relative to their performance on each of the test parameters. Author

N66-20144*# Autonetics, Downey, Calif.
PHOTODETECTOR EVALUATION FOR CELESTIAL SENSING
20 Jan. 1966 57 p Prepared for JPL
(Contracts NAS7-100; JPL-951191)
(NASA-CR-71192; C6-144/32) CFSTI: HC $3.00/MF $0.50
CSCL 09C

An evaluation was conducted to determine the characteristics of vacuum deposited thin film photoconducting cadmium sulfide for use in photodetectors under environmental conditions required for thermal sterilization and prolonged operation in space. Since many applications of photodetectors require the use of two detectors operated in a bridge configuration so that the output of one detector is balanced against a second detector, the long term null stability of two detectors operated in this manner was evaluated under wide ranges of illumination and temperature. Maximum operating limits were determined for bias voltage while in the dark and power dissipation under typical light level conditions. A test was conducted to determine detector survival for short periods at illumination levels as high as 10^{+5} foot-candles. Data are also reported on rise and fall time measurements in this material as a function of illumination levels and temperature. Tests were also conducted to determine high vacuum effects and light memory or hysteresis effects of prolonged storage in either light or dark. R.N.A.

N66-20154# Autonetics, Anaheim, Calif.
STUDY OF INFRARED PARAMETRIC AMPLIFIER Second Quarter Progress Letter Report, 1 Oct. 1965-1 Jan. 1966
D. B. Anderson, W. A. Mc Dowell, and R. R. August 3 Jan. 1966 31 p refs
(Contract Nonr-4972(00))
(AD-627141) CFSTI: HC $2.00/MF $0.50

Some considerations of nonlinear polarization susceptibility in semiconductors and the propagation through various dielectric and depletion layer waveguide structures are reviewed. The results of the device experiments carried out during this reporting period are included as halftone figures within the text. The demonstration of laser radiation propagation through a dielectric image line of dimensions

sufficiently small to demonstrate the lowest-order mode of propagation for both transverse electric and magnetic configurations is believed to be the first of its kind. TAB

N66-20213# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Fiziko-Energeticheskii Institut.

SELECTION OF A SPECTROMETRIC OPERATING MODE OF FEU-49 [VYBOR SPEKTROMETRICHESKOGO REZHIMA, FEU-49]

V. N. Kononov and V. S. Shorin 1965 6 p refs In RUSSIAN *Its* No. 2

(NP-15047)

A spectrometric operating mode of the FEU-49 photomultiplier, permitting the inherent resolution to be improved by 20% in comparison with the recommended resolution in the photomultiplier ratings, was found. The mode was chosen by regulation of the potential distribution in the photomultiplier input. The improved resolution is reached at a potential difference of 10 V between the photocathode and the modulator. Author (NSA)

N66-20216# California Univ., Livermore. Lawrence Radiation Lab.

BACKGROUND EVENTS IN PHOTOMULTIPLIER TUBES AT HIGH ALTITUDES

K. A. Anderson, G. Chodil, David Hearn, R. C. Jopson, Hans Mark et al 24 Sep. 1964 8 p refs Submitted for Publication

(Contract W-7405-ENG-48)

(UCRL-12020) CFSTI: HC $1.00/MF $0.50

A package carrying a standard type of NaI crystal assembly, lacking only the NaI crystal itself, was flown on a balloon at an altitude of 110,000 feet. The phototube output went to a five-channel pulse height analyzer, and the counts in each channel were transmitted to the ground station after suitable scaling. The channels were calibrated to correspond to the following equivalent energy intervals if the NaI crystal were mounted in the holder: channel 1, 5 to 15 keV; channel 2, 15 to 25 keV; channel 3, 25 to 35 keV; channel 4, 35 to 45 keV; channel 5, >45 keV. The counts recorded in each channel as a function of altitude are given. It is also shown that the observed counting rates correspond closely to the rates calculated for Cherenkov radiation in the glass of the phototube and crystal holder. NSA

N66-20235# Westinghouse Electric Corp., Elmira, N. Y. Electronic Tube Div.

DEVELOPMENT OF A HIGH SPEED PHOTOMULTIPLIER Progress Report, 2 Jul. 1964–2 Jan. 1965

G. R. Feaster and L. D. Owen [1965] 24 p ref

(Contract AT(30-1)-2825)

(TID-21720) CFSTI: HC $1.00/MF $0.50

Two operable tubes were obtained from 31 starts. Low dynode gain and high gas level were the principal production problems with the latter being the cause of most of the shrinkage. Effort continues toward achieving a tolerable shrinkage figure. A brief summary of progress in the development of high speed photomultiplier is given.

Author (NSA)

N66-20265# California Univ., Livermore. Lawrence Radiation Lab.

A NULL METHOD OF MEASURING MICROWAVE PHASE SHIFTS

Andrew L. Gardner 6 Aug. 1964 22 p refs

(Contract W-7405-ENG-48)

(UCRL-7978) CFSTI: HC $1.00/MF $0.50

A companion paper by Gardner and Hawke described a microwave phase shifter, with constant output, capable of rapid phase control by the bias voltage applied to varactor diodes. The application of this device to measure phase shifts in a cw microwave system by a null method is described. If phase and amplitude variations are not too fast, standard oscilloscope components can provide most of the required circuitry. Examples are given, including the measurement of 0.003° phase shift at 9 Gc in a plasma experiment.

Author (NSA)

N66-20307# Sandia Corp., Albuquerque, N. Mex.

A GUIDE FOR THE APPLICATION OF HERMETICALLY SEALED, DIRECT CURRENT, ELECTROMAGNETIC RELAYS

C. C. Bates Aug. 1965 61 p

(Contract AT(29-1)-789)

(SC-TM-65-294) CFSTI: HC $3.00/MF $0.75

A guide for circuit design engineers for the proper application of hermetically sealed, direct current, electromagnetic relays is presented. It covers relay input, relay output, operating characteristics, and contact protection. Author (NSA)

N66-20338# Sandia Corp., Albuquerque, N. Mex.

"ACCEL" AUTOMATED CIRCUIT CARD ETCHING LAYOUT

C. J. Fish and D. D. Isett Oct. 1965 30 p refs

(Contract AT(29-1)-789)

(SC-TM-65-544) CFSTI: HC $2.00/MF $0.50

Printed circuit board design time can be greatly reduced by the use of a computer program called ACCEL developed jointly by Sandia Corporation and the Thomas Bede Foundation under contract to Sandia. ACCEL is a program which designs printed circuit boards and produces the drawings for their construction. The input is encoded from an engineer's schematic diagram by a clerk with no knowledge of electronics. The outputs of the program are a schematic, parts list, printed circuit negative, assembly drawing, and a hole drilling list. ACCEL is written in Fortran II for the IBM-7090 computer and the drawings are produced on the Stromberg Carlson 4020 cathode ray tube plotter. Author (NSA)

N66-20383# Sandia Corp., Albuquerque, N. Mex.

HIGH-POWER DOUBLE-PULSE GENERATOR

G. J. Hansen Apr. 1965 9 p refs

(Contract AT(29-1)-789)

(SC-TM-65-148) CFSTI: HC $1.00/MF $0.50

A pulse generator is developed to provide a high-power double pulse of variable shape. Amplitude is variable from 0 to 1000 volts, pulse width from 0.1 to 100 microseconds, and ratio of first to second pulse amplitude from 0.1 to 1.0. Graphs and equations are determined to allow rapid calculation of pulse forming network component values.

Author (TAB)

N66-20434# Sandia Corp., Albuquerque, N. Mex.

DATA FILTER CHARACTERISTICS AND EFFECTS

J. L. Mortley Feb. 1965 12 p ref

(Contract AT(29-1)-789)

(SC-TM-65-63) CFSTI: HC $1.00/MF $0.50

The use of data filters in electronic circuits is normally considered undesirable because filtering irretrievably eliminates desirable as well as undesirable information. Filtering is necessary in some applications, however, to obtain any

useful information from measurements made in high-noise and distorted environments and from FM tape-recording and carrier-frequency-type systems. A discussion is presented of related theory and special filter characteristics necessary for retaining the maximum useful information in a filtered signal, depending upon whether the desired data are periodic or transient in nature. Author (NSA)

N66-20492# Sandia Corp., Livermore, Calif.
CLAMP-ON DIRECT-CURRENT MONITOR
E. E. Skidgel Mar. 1965 18 p
(Contract AT(29-1)-789)
(SCL-DR-C4-117) CFSTI: HC $1.00/MF $0.50

A simple clamp-on direct-current measuring module, based on the Hall effect principle, is stable and reliable throughout the normal telemetry environment and is capable of measuring direct current without interrupting the circuit being monitored. Author (NSA)

N66-20499# Sandia Corp., Albuquerque, N. Mex.
IMPROVED PACKAGING OF ELECTRONIC AND ELECTROMAGNETIC PARTS MAGNETIC PARTS
L. J. O'Connell Jan. 1965 14 p
(Contract AT(29-1)-789)
(SC-TM-65-5) CFSTI: HC $1.00/MF $0.50

A new way of mounting electronic and electromagnetic parts inside panel chassis assemblies has been developed. The new method offers prospects for reduced wiring harness sizes, better convection paths for heat dissipation, less crosstalk within the unit, easier and speedier fabrication, simpler trouble shooting, and more satisfactory location of parts that belong together. Author (NSA)

N66-20526# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
TRANSISTORIZED GENERATOR FOR PULSES OF LONG WIDTH [FORMATORE TRANSISTORIZZATO DI IMPULSI A LUNGA DURATA]
A. Alberigi Quaranta and C. Battiston (Bologna Univ.) Sep. 1964 26 p refs In ITALIAN
(RT/EL(64)-10)

The classical saturable transistorized univibrator is first studied theoretically and experimentally for use to obtain output pulses from the circuit with width greater than 0.1 sec. Two univobrator circuits capable of supplying pulses with width T=1.3 sec are described, and the performances are reported. Author (NSA)

N66-20569# Army Foreign Science and Technology Center, Washington, D. C.
NEW SERIES OF D C MICROMOTORS. SEMICONDUCTOR WATTMETER FOR HIGH-FREQUENCY UNITS
E. A. Lodochnikov, I. A. Tsyrlin, Yu. P. Shirokov, N. V. Surin, A. V. Donskoy et al Dec. 1965 15 p refs Transl. into ENGLISH from Elektrotekhnika (Moscow), no. 7, Jul. 1964 p 40–42, 44–46
(FSTC-381-T65-662; AD-627013) CFSTI: HC $1.00/MF $0.50

The DPM series of micromotors are direct-current electrical machines with excitation supplied by a permanent magnet. A description is given of switchboard semiconductor wattmeter recommended for use in industrial high-frequency units. TAB

N66-20645# Micro State Electronics Corp., Murray Hill, N. J.
ELECTRONICALLY TUNABLE YIG FILTERS WITH ELECTRONICALLY VARIABLE BANDWIDTH
Raoul Pettai Griffiss AFB, N. Y., RADC, Nov. 1965 50 p refs
(Contract AF 30(602)-3625)
(RADC-TR-65-374; AD-625957) CFSTI: HC $2.00/MF $0.50

The purpose of this work is to develop an electronically tunable YIG bandpass filter with electronically variable bandwidth. The center frequency is to vary from 2.0 to 4.0 Gc and the bandwidth from 5 Mc to 50 Mc independently of the center frequency. In this report a theoretical background is presented for the method of varying the bandwidth of a YIG filter by changing the angle between the dc biasing field H_{dc} and the incident rf magnetic field h_{rf} The results are then used to analyze single and double-resonator YIG filters. Experimental results agree with the theory for a single-resonator circuit. A two-resonator YIG filter has thus far yielded a 3.2:1 change in bandwidth but at the expense of a 12 db insertion loss at the narrowest (5 Mc) bandwidth. The role of the coupling coefficient K between the YIG resonators is analyzed since the rapid increase of insertion loss and the failure to obtain larger changes in bandwidth is felt to be due to variations in K such that the product KQ_e does not remain constant. Experimental results are presented for a two-resonator YIG filter using a number of differently shaped coupling apertures. Author (TAB)

N66-20669# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
400 CPS VARIABLE SPEED GENERATOR SYSTEM. VOLUME I: (KC-135 VSCF PROGRAM) Final Report
Forrest P. Schregardus 15 Dec. 1964 138 p refs
(Contract AF 33(657)-7999)
(Rept.-51907, Vol. I; AD-626140) CFSTI: HC $4.00/MF $1.00

A 40 KVA variable speed constant frequency (VSCF) generator system was reduced to aircraft-type hardware size. It met or exceeded requirements in the areas of steady state voltage regulation, overload, manual control, speed stability, motor starting, and voltage modulation. The VSCF system is rugged both electrically and mechanically as was shown by over 500 faults applied to the system during development, testing, and demonstration. The system has a high rate of response to changes in input or load, and can be operated parallel and divide loads accurately with stability comparable to the best quality conventional systems. The basic electronic nature of the VSCF system makes it ideal for microminiaturization. Blast or forced air cooling is necessary for a lightweight frequency changer. However, as components become concentrated, electromagnetic interference between circuits increases and care must be used in preventing undesirable effects. Frequency changer technology has advanced to a point where the cycloconverter is a practical and useful device. R.N.A.

N66-20673# General Electric Co., Palo Alto, Calif.
LOW NOISE 26–40 GC TWT DEVELOPMENT Interim Report, 31 Dec.–1 Jul. 1965
W. E. Raub Griffiss AFB, N. Y., RADC, Dec. 1965 28 p
(Contract AF 30(602)-3617)
(R65ELM262-1; RADC-TR-65-333; AD-626383) CFSTI: HC $2.00/MF $0.50

The report covers the work of the first 6 months of a 15 month program for the development of Ka-band (26 to 40 Gc), low noise traveling wave tube amplifier. The initial tube design and construction techniques are reviewed under the

headings helix, low noise gun, overall tube design, and mechanical design of tube, jigs, and fixtures. From study of the many factors involved, the initial helix design analysis was based on a gamma at 40 Gc of 2.9, a cathode to helix diameter of 0.5, and a beam of 400 a. Helix calculations at 2000 v, 2500 v, and 3000 v, indicated that a two section helix at approximately 2000 v input and 3000 v output is best for this Ka-band tube. The low noise gun considerations are based on the two important gun regions: the low noise diode region and the noise wave transformer region. Due to the small cathode diameter imposed by the high frequency, a cathode with side coating, which will increase the emitting area over that obtained with a parallel flow gun, is discussed. Mechanical design and assembly jig and fixture techniques, which are extremely important to the successful development of a Ka-band tube, were evaluated, and it was determined that the gun stack alignment to the helix ID and the cathode alignment to the gun stack are the most critical construction areas. TAB

N66-20679# Army Electronics Labs., Fort Monmouth, N. J.
SEMICONDUCTOR LIMITERS AS MICROWAVE DUPLEXING DEVICES
V. J. Higgins, R. Brunton (Microwave Associates, Inc.), and G. Hall Sep. 1965 17 p refs
(ECOM-2630; AD-627085) CFSTI: HC $2.00/MF $0.50

The report covers the design, development, and evaluation of two X-band semiconductor limiters. The limiters were developed for application as duplexing devices in the man-packed battlefield radar systems AN/PPS-4 and AN/PPS-6. The limiters operate at peak powers of 500 and 1000 watts over a 500 Mc bandwidth and 0.001 duty cycle. Design and construction of the basic limiter is described, including means of incorporating PIN and varactor diodes in waveguides, together with a technique for achieving passive limiter operation. Test methods and complete test results are given in the electrical evaluation of the limiters as microwave duplexing devices. Author (TAB)

N66-20721# Michigan Univ., Ann Arbor.
INVESTIGATION OF LARGE-SIGNAL KLYSTRON AND TRAVELING-WAVE DEVICES Quarterly Progress Report No. 4, 1 Jun.–1 Sep. 1965
G. T. Konrad and J. E. Rowe Griffiss AFB, N. Y. RADC, Dec. 1965 48 p refs
(Contract AF 30(602)-3569)
(RADC-TR-65-430; AD-626806) CFSTI: HC $2.00/MF $0.50

The behavior of Brillouin beams in TWA's is evaluated. The effects of magnetic field strength, as well as other parameters, on the beam geometry and the rf voltage buildup along the beam are presented. The radial distribution of electrons at the saturation plane is also determined for typical operating parameters. The continuation of work on the nonlinear, boundary-value problems in electron and plasma devices is described. A method of integrating the equations is presented and the error propagation in the solution is discussed. Experimental results obtained in the beam analyzer on a solid beam gun are described. This gun is to be used eventually in the beam stability experiments in the presence of large-signal rf. The magnetron injection gun computer program work is described. The cathode current density can now be reliably handled in the program, but cycloiding problems at the cathode are still shown to be present. The initial results from testing the UHF tube containing a magnetron injection gun are discussed. Future plans for this work are outlined. Operation under cw conditions is shown to be necessary in order to obtain noise measurements on the tube. Author (TAB)

N66-20722# Sprague Electric Co., North Adams, Mass.
STUDY, INVESTIGATION, AND DEVELOPMENT OF NONDESTRUCTIVE RELIABILITY SCREENING OF METALLIZED MYLAR CAPACITATORS Interim Technical Documentary Report
E. Rondeau Griffiss AFB, N. Y., RADC, Dec. 1965 25 p (Contract AF 30(602)-3632)
(RADC-TR-65-447; AD-626992) CFSTI: HC $1.00/MF $0.50

The scope of work being performed is reviewed, and the self-healing mechanism unique to metallized Mylar capacitors is described. The principal failure modes of these capacitors are listed. The procedures used to determine the proper measurement conditions for nondestructive screening are presented. The techniques used to analyze the results of these investigations are outlined. The measurement conditions which showed the largest dispersions of results are: for insulation resistance −300 VDC at 65C; for dissipation factor 30 VAC, 100 cps, at 85C. An additional experiment selected conditions of 250 VAC, 60 cps, at 25C for the test. The details of this experiment are described. The program for the cleared units are given. One portion of the clearing test remains to be accomplished. The program for the burn-in test is outlined, and the test matrix is presented. The results of life testing the burned-in units are being analyzed. Author (TAB)

N66-20740# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
LITERATURE SURVEY ON ELECTROTECHNOLOGY [ELECTROTECHNIEK, LITERATUUROVERZICHT]
7 Feb. 1966 39 p refs In DUTCH, ENGLISH, and GERMAN *Its* Vol. 15, No. E-480
CFSTI: HC $2.00/MF $0.50

Abstracts and bibliographic notes are included on the topics of telecommunications, electronics, electromagnetic radiation, geometry, information processing, computers (software and hardware), computer applications, measurement techniques, control techniques, reduction, interference and reliability, oscillators and magnifiers, components and materials, filters and networks, energy techniques, presentations, and technical news. Transl. by J.O.

N66-20806# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
MICROWAVE TRANSISTORS Quarterly Report No. 1, 1 Jun.–31 Aug. 1965
George Johnson, Dave Boone, and Julius Lange Oct. 1965 40 p refs
(Contract DA-28-043-AMC-01371(E))
(TI-03-65-106; AD-626379) CFSTI: HC $2.00/MF $0.50

A preliminary design study of a $3GH_z$ and a $6GH_z$ low-noise transistor was made. The general approach to the development of these transistors is discussed along with calculated operating parameters and some of the developmental problems involved. P-type diffusion studies have been carried out under both vacuum and atmospheric pressures conditions in an attempt to obtain the desired base surface concentrations required for high frequency transistor development. It was found that surface concentrations from vacuum diffusions were not reproducible to a satisfactory degree, but those from open-tube diffusions show definite promise. Further refinements of the open-tube process are planned. Circuit development work centered around the design of an S-band voltage tunable oscillator. Prototype fixed frequency designs were fabricated and tested. The results indicate the method of design and circuit realization techniques were satisfactory. The design of a prototype voltage tunable S-band oscillator on

ceramic has been completed. Calculations show the circuit will be able to be fabricated in a very small enclosure approximately 300 mils on a side. Author (TAB)

N66-20807# Advanced Kinetics, Inc., Costa Mesa, Calif.
INDUCTIVE STORAGE SWITCH STUDY Final Report
H. P. Furth, R. W. Waniek, D. M. Fitzgerald, T. Emil, W. L. Lobdell et al Griffiss AFB, N. Y., RADC, Dec. 1965 110 p refs
(Contract AF 30(602)-3512)
(RADC-TR-65-297; AD-626764) CFSTI: HC $4.00/MF $0.75

An 'interrupter' switch was designed and fabricated for use with inductive energy storage devices in pulsed modulator applications. The storage inductor and related circuitry has also been designed keeping in mind the cooling techniques to be employed and the uses of the modulator system. The switch makes use of a low impedance liquid metal–metal contact during the conduction cycle and is opened by a pulsed magnetic field which physically moves the liquid metal away from the solid metal contact. Author (TAB)

N66-20811# Fairchild Semiconductor Corp., Palo Alto, Calif. Research and Development Labs.
UHF SMALL SIGNAL TRANSISTOR Final Report, 1 Apr. 1964–15 Aug. 1965
David K. Myers and M. Purnaiya [1965] 128 p refs
(Contract DA-28-043-AMC-00040(E))
(Rept.-5; AD-625433) CFSTI: HC $4.00/MF $0.75

The shipment of transistors consists of 30 transistors in the stripline package, and 70 transistors in a modified TO-18 package and 10 transistors in a TO-51 package. A detailed analysis of all experimental data is given. All transistors meet or exceed the primary requirements on power gain, stability, and noise figure. This includes a gain figure greater than or equal to 37.0 db; unilateral gain greater than or equal to 12 db; stability factor between 0.7-1.5; and noise figure less than 6 db at 500 Mc at the operating level of 12 mW. Reliability data on units mounted in the stripline, TO-18 and TO-51 package are furnished. Author (TAB)

N66-20817# Sylvania Electric Products, Inc., Woburn, Mass.
RELIABILITY ANALYSIS OF X-BAND TUNNEL DIODES Final Report
Charles Davis and Arthur Lueck Griffiss AFB, N. Y., RADC, Dec. 1965 74 p refs
(Contract AF 30(602)-3487)
(RADC-TR-65-291; AD-625956) CFSTI: HC $3.00/MF $0.75

The report presents an account of a microwave tunnel diode improvement program, and the results obtained from reliability tests performed on devices fabricated by the improved processes. A new solid structure tunnel diode was developed during this contract which exhibits superior reliability characteristics to any previously tested tunnel diode. The process and fabrication details for this device along with reliability data are included in the report. Author (TAB)

N66-20824# National Bureau of Standards, Washington, D.C. Inst. of Applied Technology.
STUDIES OF SECOND BREAKDOWN IN JUNCTION DEVICES Final Report, 1 Sep. 1963–Aug. 1965
H. A. Schafft and J. C. French Griffiss AFB, N. Y., RADC, Dec. 1965 81 p refs
(Contract AF 30(602)-3253)
(RADC-TR-65-272; AD-626389) CFSTI: HC $3.00/MF $0.75

The report is divided into three sections. The first section is concerned with a study of second breakdown characteristics of transistors and how they are affected by the internal current distribution. The results of this study, which included the use of temperature-sensitive phosphors to reveal current distributions, have emphasized how intimately the susceptibility of the transistor to second breakdown is linked to the distribution of current or energy dissipation within the transistor. The second section concerns the study of the effect on second breakdown of crystallographic defects, detectable by means of x-ray diffraction microscopy. The susceptibility to second breakdown of about 1500 epitaxial planar silicon transistors diffused on two wafers was measured; the current construction of second breakdown was marked on most of these transistors. The third section presents an outline of the characteristics of second breakdown which is used to provide an understanding of the variety of approaches that the transistor industry has used to specify conditions of transistor operation free of second breakdown. These approaches are reviewed and discussed with the aim of maximizing their usefulness. Author (TAB)

N66-21012*# Borg-Warner Corp., Bedford, Ohio. Pesco Products.
A STUDY OF ELECTRIC MOTORS FOR USE IN LIQUID AND GASEOUS HELIUM Engineering Report No. 3530
F. W. Bott, G. H. Caine, and A. V. Pradhan 9 Mar. 1966 209 p refs
(Contract NAS9-4923)
(NASA-CR-65277) CFSTI: HC $6.00/MF $1.25 CSCL 09C

Information and data generated from a study of the application of electric motors in both liquid and gaseous helium environments are reported. Problems relating to structure, bearings, and heat rejection were investigated. Also studied and discussed are the electrical and magnetic design, the mechanical design, and the effects of fluid. Recommendations are made. Sample stress calculations and a bibliography on cryogenic engineering are presented; and useful tabulated data to provide a motor selection guide for motors operating in helium temperatures from −453°F to +70°F and pressures from 10 psia to 3000 psia are given. L.S.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-19882*# Arizona Univ., Tucson. Engineering Research Labs.
RESEARCH IN AND APPLICATION OF MODERN AUTOMATIC CONTROL THEORY TO NUCLEAR ROCKET DYNAMICS AND CONTROL, VOLUME I Semiannual Status Report
Lynn E. Weaver, Donald G. Shultz, James L. Melsa, Philip A. Secker, Donald M. Nordal et al Feb. 1966 329 p refs
(Grant NsG-490)
(NASA-CR-70862) CFSTI: HC $7.00/MF $1.75 CSCL 09C

CONTENTS:
1. OPTIMAL FEEDBACK CONTROL OF NUCLEAR REACTOR SYSTEMS 146 p refs (See N66-19883 10-10)

2. MODELING WITH LIAPUNOV FUNCTION 95 p refs (See N66-19884 10-10)

3. LINEAR SYSTEMS DESIGN USING STATE VARIABLE FEEDBACKS 64 p refs (See N66-19885 10-10)

N66-19883* Airzona Univ., Tucson. Engineering Research Labs.

OPTIMAL FEEDBACK CONTROL OF NUCLEAR REACTOR SYSTEMS

In its Res. in and Appl. of Mod. Autom. Control Theory to Nucl. Rocket Dyn. and Control, Vol. I 146 p refs (See N66-19882 10-10) CFSTI: HC $7.00/MF $1.75

Linear optimal feedback control theory is employed for the synthesis of several nuclear reactor models. Optimal feedback control theory is presented from the viewpoints of three commonly used techniques in modern control theory, namely: the calculus of variations, Pontryagin's maximum principle, and Bellman's dynamic programming. The purpose of this study is to derive analytical expressions for a compensating reactivity control which minimizes an integral quadratic performance index containing system errors and control motions. Higher-than-first-order nuclear reactor models are analyzed for optimal linear and quasi-optimal non-linear cases. Analog computer studies show the effect of quasi-optimal feedback control in minimizing system errors caused by internal dynamic disturbances. The examples in this work demonstrate the usefulness of optimal feedback control synthesis for nuclear reactor systems. Author

N66-19884* Airzona Univ., Tucson. Engineering Research Labs.

MODELING WITH LIAPUNOV FUNCTION

In its Res. in and Appl. of Mod. Autom. Control Theory to Nucl. Rocket Dyn. and Control, Vol. I Feb. 1966 95 p refs (See N66-19882 10-10) CFSTI: HC $7.00/MF $1.75

The sole purpose of this work is to develop a technique by which lower order models can be obtained for linear control systems. This technique is based entirely on Liapunov V functions and thus serves to extend the usefulness of Liapunov functions from strict stability analysis to relative stability analysis. With this modeling technique, relative stability can also be determined by observing the behavior of the model. For systems with no zeros the second order model and the phase margin model are shown to be approximately equivalent. The third order model developed from Liapunov V functions is a better approximation to high-order systems than the phase margin and second order models. Unfortunately, systems with zeros complicate the modeling process. While the method is still valid and workable, difficulty arises in interpreting the results of the method. Author

N66-19885* Arizona Univ., Tucson. Engineering Research Labs.

LINEAR SYSTEMS DESIGN USING STATE VARIABLE FEEDBACKS

In its Res. in and Appl. of Mod. Autom. Control Theory to Nucl. Rocket Dyn. and Control, Vol. I Feb. 1966 64 p refs (See N66-19882 10-10) CFSTI: HC $7.00/MF $1.75

A time-domain approach to the control of linear, constant coefficient systems with unconstrained control efforts was studied. This method used first-order differential equations, obtained directly from differential equations describing the automatic control system, to form block diagrams for a regulator design. All performance requirements were embodied in a single specification called the performance index; the effects of feeding back all the state variables on the poles and zeroes of the system were developed and the feedback coefficients for a given design problem were obtained from the relationship between the parameter optimization problem and the regulator problem. A servo-mechanism problem solution was obtained in a similar way. G.G.

N66-20083*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

PART I: COMPUTER-AIDED ELECTRONIC CIRCUIT DESIGN. PART II: CONDUCTION PROCESSES IN THIN FILMS Status Report, Jun. 1-Nov. 30, 1965

Dec. 1965 58 p refs

(Grant NsG-496)

(NASA-CR-70940; ESL-SR-256) CFSTI: HC $3.00/MF $0.50 CSCL 09C

Research was conducted on electronic circuit design through use of on-line time shared computers, and developments on several computer programs are described. Also reported are efforts to simulate nonlinear networks in time shared computers. In addition, research was carried out on thin film conduction processes in an attempt to understand the mechanisms by which conduction takes place in semi-insulating films, and between sandwiched layers of these films. Studies on a thin film coincident-frequency memory concept are summarized. D.T.

N66-20095# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

[JOINT SERVICES ELECTRONICS PROGRAM] Final Scientific Report, 1 May 1963-30 Apr. 1964

11 Jun. 1965 36 p refs

(Grant AF-AFOSR-453-63)

(PIBMRI-1278-65; AFOSR-65-1493; AD-624297) CFSTI: HC $2.00/MF $0.50

The research program includes the five areas of Electromagnetics, Microwave Networks and Techniques, Information Processes, Feedback and Control, and Nonlinear Circuits. TAB

N66-20101* Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

PROBABILITY OF ERROR FOR CORRELATORS WITH NOISY REFERENCE SIGNALS

P. A. Wintz *In its* [Commun. Sci.] [1965] p 19-23 (See N66-20097 10-07) CFSTI: HC $3.00/MF $0.50

A simple correlator was analyzed for its error probability of detecting reference signals in noise. Its input waveform consisted of a deterministic signal of T seconds duration plus a random perturbation n(t) called noise. The reference waveform also consisted of a deterministic signal r(t) of T seconds duration plus a random component m(t) also called noise. The output of the integrator z(t) was sampled at t=T, and the statistics z (T) were used in the decision process. An appropriate set of orthonormal basis functions were applied to approximate the required waveform by finite dimensional vectors. Also considered were the characteristic function, probability density function, and the probability distribution function for the random variable of non-identical signals in two channels. G.G.

N66-20480# Sandia Corp., Albuquerque, N. Mex.
GUARDED CIRCUITS
R. K. Treece Mar. 1965 10 p
(Contract AT(29-1)-789)
(SC-TM-65-106) CFSTI: HC $1.00/MF $0.50

An outline is presented of the theory of guarded, high-impedance circuits. Two examples are used to illustrate guarding techniques and to indicate areas of practical application. Author (NSA)

N66-20606# Joint Publications Research Service, Washington, D. C.
NEWS OF THE ACADEMY OF SCIENCES USSR, DEPARTMENT OF TECHNICAL SCIENCES, TECHNICAL CYBERNETICS, NO. 6, 1965
11 Mar. 1966 296 p refs Transl. into English of the Publ. Izv. Akad. Nauk. SSBR, Otd. Tekhn. Nauk: Tekhn. Kibernetika (Moscow), No. 6, Nov.–Dec. 1965 p 1-184
(JPRS-34515; TT-66-30955) CFSTI: $6.00

Selected articles on cybernetics and computer solutions to statistical probability problems are presented. For individual titles see N66-20607–N66-20629. Author

N66-20609 Joint Publications Research Service, Washington, D. C.
A CONTROL SYSTEM WITH UNLOADED RESERVE
I. T. Borisenok and B. M. Balakin *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 28-31 refs (See N66-20606 10-10) CFSTI: $6.00

The control system with reserve [1] is investigated for which part of the doubling executive organs are loaded, and part are unloaded [2]. A procedure is proposed for detecting the breakdowns in the system and switching in the reserve unloaded servomechanisms which ensure normal operation of the control system. Author

N66-20610 Joint Publications Research Service, Washington, D. C.
RELIABILITY OF SUBSYSTEMS WHICH ARE ISOLATED IN A RESERVE SYSTEM WITH REPAIR
B. A. Kozlov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 32-39 refs (See N66-20606 10-10) CFSTI: $6.00

A repairable system made up of n+m elements of which m elements are used as a sliding reserve is investigated. The average time of operation before breakdown of one of the isolated operating elements is estimated. Author

N66-20612 Joint Publications Research Service, Washington, D. C.
RELIABILITY OF A SYSTEM IN THE RANDOM CONDITION OF OPERATION
S. Yu. Ruderman *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 55-59 refs (See N66-20606 10-10) CFSTI: $6.00

The characteristics of the time of existence of a system taking into account the busy condition for it are calculated. Author

N66-20613 Joint Publications Research Service, Washington, D. C.
THE ITERATION METHOD FOR CONSTRUCTING SYSTEMS WITH FIXED RANDOM PARAMETERS
V. F. Yevseyev, T. D. Korablina, and S. I. Rozhkov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 60-72 refs (See N66-20606 10-10) CFSTI: $6.00

The problems of selection of optimal parameters of systems with the given structure on the basis of the requirements imposed on their output characteristics are investigated. By structure we mean the functional inequalities $\psi(x) \geq 0$ which define the conditions of operation of the system. The solution is offered for the two engineering problems. In the first the tolerances of the output characteristics of the system are minimized for given tolerances on the random variables. In the second, the tolerances are maximized for the random parameters of the system for fixed limitations on the output characteristics of the system. When constructing the algorithms for solution of the problem of selection of the optimal parameters of the system on digital computers, the ideas of the practical method of limited tests are used along with game theory, and the method of statistical chess (Monte Carlo Method) is used. The result of synthesis of specific systems is presented. Author

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N66-20614 Joint Publications Research Service, Washington, D. C.
ON THE BASIC RELATIONSHIPS OF TERNARY-PENTARY MAJORITAL ALGEBRA
Ye. A. Samokhvalov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 73-86 refs (See N66-20606 10-10) CFSTI: $6.00

For united majorital algebra including the five place and three place operations, procedures are proposed for translation of boolean functions into majorital functions; basic identities are presented which form the basic laws of majorital algebra similar to the basic laws of boolean algebra; the completeness of the system of basic identities is proved permitting the conversion of the majorital expressions into any expression equivalent to it; a number of derivatives of the identities are presented which make these transformations simpler. Author

N66-20624 Joint Publications Research Service, Washington, D. C.
SELF-ADJUSTING SYSTEMS WITH ESTIMATION OF THE DAMPING WITH RESPECT TO PHASE SHIFT
N. T. Kuzovkov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 200-213 refs (See N66-20606 10-10) CFSTI: $6.00

A new principle of seld-adjustment of closed automatic control systems is proposed for a given or maximum possible damping coefficient ζ of the free oscillations included in the automatic evaluation of the current damping coefficient ζ with respect to phase shift between any coordinate of an autocontrolled system x and its derivative x and in the corresponding variation of the amplification coefficient with respect to the circuit of this system. The results are presented from an experimental investigation of a self-adjusting automatic control system constructed according to this principle. Author

N66-20625 Joint Publications Research Service, Washington, D. C.
ANALYTICAL CONSTRUCTION DIGITAL REGULATORS BY THE METHOD OF DYNAMIC PROGRAMMING
P. D. Krut'ko *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 214-221 refs (See N66-20606 10-10) CFSTI: $6.00

By the method of dynamic programming, the problem of determination of the equations of optimal digital regulators is solved for systems of control of disturbed motion. As the criterion of optimalness, the minimum of the generalized quadratic evaluation of the transition process is assumed. Author

N66-20626 Joint Publications Research Service, Washington, D. C.
ON A METHOD OF SOLUTION OF OPTIMAL PROBLEMS WITH BOUNDARY CONDITIONS
G. M. Ostrovskiy, Yu. M. Volin, I. I. Malkin *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 222–230 refs (See N66-20206 10-10) CFSTI: $6.00

A method of sequential approximations for the solution of problems with boundary conditions in the right-hand side of an integration interval is investigated. Author

N66-20627 Joint Publications Research Service, Washington, D. C.
CALCULATION OF THE NONLINEAR MUTUAL INFLUENCE OF CHANNELS IN CERTAIN TYPES OF AUTOMATIC CONTROL SYSTEMS
A. D. Maksimov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 231–243 refs (See N66-20606 10-10) CFSTI: $6.00

The problems of dynamics of operation of certain two channel automatic control systems are investigated taking into account the nonlinear mutual influence of the channels. The solution is carried out by the asymptotic procedure of N. M. Krylov and N. N. Bogolyubov presented in the appendix. The conditions of "capture" and entry into auto-accompaniment are investigated in quite general form. In the appendix also the derivation of the control function for radar systems is presented. Author

N66-20672# Naval Postgraduate School, Monterey, Calif.
A CASE STUDY OF THE DISCRETE OPTIMUM FILTER-CONTROLLER PROBLEM
James S. Demetry, Robert D. Strum, and Harold A. Titus Nov. 1965 44 p refs
(RP-57; AD-626204) CFSTI: HC $2.00/MF $0.50

An example is given of the steps and calculations necessary to the synthesis of the discrete optimum controller and Kalman filter for the control of a linear, time invariant plant whose state is only partially observable. The plant is subject to random excitation, and the observables are contaminated by random measurement noise. The optimum control is a linear function of the best estimate of the system state variables. The controller gains are obtained from the steady-state solution of a set of recursion equations arising from a dynamic programming approach to the minimization of a quadratic index of performance. The optimum filter is essentially a model of the plant. The state of the model is the best current estimate of the state of the plant. The estimate is updated at each sampling instant by taking the difference between the observed state of the plant and the predicted state of the model. This difference vector is multiplied by a 'gain' matri to adjust the model. The elements of the filter gain matrix are obtained from the steady-state solution of a set of recursion equations developed by Kalman. TAB

N66-20682# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Electrophysics.
SELECTED TOPICS IN MODERN NETWORK THEORY
Dante C. Youla Griffiss AFB, N. Y., RADC, Oct. 1965 87 p refs
(Contract AF 30(602)-2868)
(PIBMRI-1258-65; RADC-TR-65-259; AD-626269) CFSTI: HC $3.00/MF $0.75

This report is a research monograph which presents in depth a sample of many developments in network theory which have taken place within the last decade. Most of the preoccupation is with 1 and 2 part networks with the results inspired by the desire to build better linear filters. In particular known results on two variable positive real functions, inspired by a consideration of network building blocks of both lumped and distributed parameter type, is included.
Author (TAB)

N66-20684# Delaware Univ., Newark.
MAGNETIC AND AERODYNAMIC NOISE OF HIGH SPEED ALTERNATING CURRENT GENERATORS AND THEORY OF HOMOPOLAR ALTERNATORS. PHASE B, PART III: MANUAL FOR FLUX DISTRIBUTIONS IN HOMOPOLAR INDUCTOR ALTERNATORS
K. K. Surti and Edward A. Erdelyi Jul. 1964 116 p refs
(Contract DA-44-009-ENG-4830)
(AD-627083) CFSTI: HC $4.00/MF $0.75

This manual is presented to enable technical personnel to prepare computer programs for finding the flux distribution of a homopolar alternator design. The program presented outlines details and techniques ascertained by the originators and does not describe the analyzed machine itself. Discussed are the preparation of cross section in Cartesian coordinates, corrected air gap length, the grid design, constants of the magnetization curve, the potentials on the axis of symmetry, preparation of the main program, and computer program, operations in the main program, output, Fourier series, a review of the theory of homopolar alternator on balanced load, and preparation of the program for homopolar alternator on balanced loads. The appendices contain the programs for fixed potentials, homopolar alternator at no-load, homopolar alternator on balanced loads, and Fourier analysis. R.N.A.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-19793# Kitt Peak National Observatory, Tucson, Ariz.
[KITT PEAK NATIONAL OBSERVATORY] MONTHLY REPORT, DECEMBER 1965
[1965] 29 p refs

Research activities at the stellar, space, and solar divisions of the Kitt Peak National Observatory are summarized. Use of various telescopes is discussed, and the region of the sodium D lines at λ5893 Å at high sun and at sunset is illustrated. Progress is reported for a project dealing with a remotely controlled telescope for future space flight applications. M.W.R.

N66-19894 Joint Publications Research Service, Washington, D. C.
SPACE VEHICLE OPERATIONAL STATIONS
Hsing-i Ch'ien *In its* Transl. on Communist China's Sci. and Technol., No. 296 3 Mar. 1966 p 1–5 (See N66-19893 10-34) CFSTI: $2.00

The requirements for a modern space vehicle operational launch facility are described for four areas: the launching station, rocket operational region, recovery region, and operational control center. The equipment and facilities necessary for the launch station are mentioned, and the need for multiple launch pads and the function of the rocket control center are briefly discussed. Tracking and telemetry stations are required at the launch site and along the rocket flight path and provision must be made for land or water recovery of the vehicle. The complexity of the large land areas required for the total facility and sub-facilities as well as the space and personnel needed for the management area and other areas of the facility are included. E.A.O.

N66-19896 Joint Publications Research Service, Washington, D. C.
GROUND INSTALLATIONS FOR MAJOR ROCKETS
Yu Cheng *In its* Transl. on Communist China's Sci. and Technol., No. 296 3 Mar. 1966 p 11–15 (See N66-19893 10-34) CFSTI: $2.00

The functions and standards of major equipments used in rocket launch installations are outlined. These include equipment for transporting rockets to the launch pad, checkout and test equipment, fueling equipment, launching equipment, launch control equipment, and electric power supply equipment. The importance of high standards in constructing ground installations is stressed. Brief mention is also made of the different types of launch installations, including fixed, mobile, and underground launch pads; the trend toward standardizing ground equipment and lowering construction time and costs; and installation construction demands on industry. R.N.A.

N66-19967# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut für Angewandte Gasdynamik.
THE LOW SPEED WIND TUNNEL OF THE DVL AT PORZ-WAHN. PART II: IMPROVEMENTS ON AERODYNAMIC QUALITIES AND EQUIPMENT [DER UNTERSCHALL-WINDKANAL DER DVL IN PORZ-WAHN. TEIL II: VERBESSERUNGEN UND ENTWICKLUNGEN AN DEN EIGENSCHAFTEN UND EINRICHTUNGEN]
G. Schulz and G. Viehweger Jul. 1965 61 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-56; DVL-476) CFSTI: HC $3.00/MF $0.75

This report on the low speed wind tunnel at Porz-Wahn contains several fundamental measurements and calibrations. The nature of the so-called "pumping", i.e. of the pulsations of the air speed is treated in detail. This effect has been fully eliminated. Measurements on the parallelity of the free stream, its direction towards the duct, its turbulence factor, and the production of noise are also communicated. The pressure tanks of the new air supply serve for simulating engine jets on aircraft models, especially on VTOL aircraft. Author

N66-19970# Royal Aircraft Establishment, Farnborough (England).
REPORT ON A VISIT TO SOME ACOUSTIC FACILITIES IN THE U.S.A.
D. R. B. Webb Sep. 1965 73 p
(RAE-TR-65170) CFSTI: HC $3.00/MF $0.75

A visit to fourteen acoustic facilities in the U.S.A. was made in 1964 to obtain information on the design of acoustic facilities at the R.A.E. Only general descriptions of the facilities are given, since the writer's interest was centered around methods of testing in them. Full details of the facilities were, however, often provided by the organizations visited. Author

N66-20020# Naval Ordnance Lab., White Oak, Md.
GLASS FIBER DRAWING AND MEASURING FACILITIES AT THE U.S. NAVAL ORDNANCE LABORATORY
Joy R. Fisher 23 Jun. 1965 41 p refs
(NOLTR-65-87; AD-618501) CFSTI: HC $2.00/MF $0.50

Glass fiber drawing facilities and apparatus for measuring the physical properties of these fibers have been assembled at NOL for research and development purposes. The fiber drawing facilities include a small wire wound furnace for preliminary studies and a high amperage furnace for longer ranged research programs, such as a study of the effect of finishes on the strength of glass-resin composites. Measurement facilities are provided for determining the following properties of glass fibers: diameter, density, tensile strength, and modulus of elasticity. Alternative methods for measuring diameter and density are also given. Author (TAB)

N66-20372# Oak Ridge National Lab., Tenn.
AN AIR-PULSED LABORATORY MIXER-SETTLER
R. E. Mc Henry and J. C. Posey Sep. 1964 22 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-896) CFSTI: HC $1.00/MF $0.50

A new all-glass laboratory scale air-pulsed mixer–settler was designed, constructed, and tested under a wide variety of operating conditions. This contactor was designed for processing of radioactive materials and has no moving parts. The interface stability, stage efficiency, and flow capacity were evaluated. Very high interface stability and stage efficiency were found to be characteristic of this mixer–settler. Flow capacities were correlated with the density difference in the light and the heavy phases and with resistance to flow
Author (NSA)

N66-20383# Oak Ridge National Lab., Tenn.
THE JOINT NATIONAL INSTITUTES OF HEALTH-ATOMIC ENERGY COMMISSION ZONAL CENTRIFUGATION PROJECT. I. THE DEVELOPMENT OF LOW-SPEED ZONAL ROTORS
N. G. Anderson, H. P. Barringer, C. E. Nunley, R. E. Canning, E. F. Babelay et al Oct. 1964 18 p refs
(Contract W-7405-ENG-26)
(ORNL-3613) CFSTI: HC $1.00/MF $0.50

Two low-speed zonal centrifuge rotors (designated A-V and A-VI) were developed to test the feasibility of zonal separation of particles in the micron size range. Based on these studies rotor A-IX was designed. It has a capacity of 1300 ml, a maximal design speed of 6000 rpm, and suitable seals to allow the gradient and sample layer introduction as well as gradient and zone recovery during rotation. The applicability of this rotor to the problem of isolating subcellular particles is demonstrated. Author (NSA)

N66-20419# Oak Ridge National Lab., Tenn. Civil Defense Study Group.
THE CAPABILITY, CREDIBILITY, AND DESIRABILITY OF BLAST SHELTER SYSTEMS: A SYSTEM FOR ANALYSIS

Sue Berryman Bobrow May 1965 22 p
(Contract W-7405-ENG-26)
(ORNL-TM-1089) CFSTI: HC $2.00/MF $0.50

This report distinguishes between grossly different types of blast shelter systems and the categories of variables relevant to their evaluation. It lists important variables (physical, physiological, psychological, cultural, economic, and political) for the categories, and where it is possible, scores alternative systems on each variable. Author

N66-20431# Mechanical Technology, Inc., Latham, N. Y.
DESIGN CONSTRUCTION AND CHECKOUT OF A HIGH-TEMPERATURE RESEARCH LOOP FACILITY Summary Report, Period Ending 18 Sep. 1964
P. W. Curwen 17 Mar. 1965 114 p
(Contract AT(30-1)-3237)
(NYO-3237-2; MTI-65TR8) CFSTI: HC $4.00/MF $0.75

The High-Temperature Research Loop is an engineering facility which can be used for developmental testing of mechanical, electrical, and electro-mechanical components (or systems) which require high-temperature gas flow to simulate actual operating conditions. The facility constitutes a sealed, recirculating gas-flow system which can generate gas temperatures as high as 1600° F. Loop pressure may be varied from vacuum conditions to 500 psi. A wide variety of gases, such as argon, helium, neon, and nitrogen, can be used. The design and construction of the facility, preparation of instrumentation, and laboratory checkout of the first developmental component schedule for testing in the loop are discussed in detail. The first developmental component to be tested in a gas-bearing Brayton cycle turbocompressor; the combination of loop and turbocompressor will comprise a closed, recirculating Brayton cycle system. (NSA)

N66-20539# California Univ., Berkeley. Lawrence Radiation Lab.
PRODUCTION TECHNOLOGY OF SPARK CHAMBERS
A. I. Alikhanyan Aug. 1965 7 p Transl. into ENGLISH of a Lecture Draft
(UCRL-Trans.-1193) CFSTI: HC $1.00/MF $0.50

The construction of two types of spark chambers are described: those for evacuation and filling outside the pressure chamber, and those for which these operations are carried within the chamber. NSA

N66-20829# Polytechnic Inst. of Brooklyn, Freeport, N. Y.
PERFORMANCE ANALYSIS OF A SUPERSONIC MECHANICAL ACCELERATOR
Robert J. Cresci and C. Waldman Wright-Patterson AFB, Ohio, ARL, Oct. 1965 40 p refs
(Contract AF 33(657)-8286)
(PIBAL-820; ARL-65-213; AD-626981) CFSTI: HC $2.00/MF $0.50

The performance of a three stage axial flow compressor was computed to evaluate the compressor exit flow properties for various rotor tip speeds and inlet conditions. The compressor operates with supersonic relative velocities in all stages, and has blading with large turning angles. The analysis includes the effects of local heat transfer to the wetted surfaces. The analysis is performed using the results obtained from two dimensional cascade experiments for pressure recovery and local heat rates. The compressor is of the impulse type, therefore, relatively large increases in total pressure and total temperature are achieved in each stage. Real gas effects are included in the analysis by utilizing curve fits to the Mollier diagram for air in chemical and the thermodynamic equilibrium; this is necessary for the pressure and temperature levels achieved in the compressor. Author (TAB)

N66-20837# New York Univ., N. Y.
A HIGH MACH NUMBER HIGH REYNOLDS NUMBER HYPERSONIC FACILITY Final Report
Antonio Ferri, Victor Zakkay, and Lawrence Carr Wright-Patterson AFB, Ohio, ARL, Oct. 1965 34 p ref
(Contract AF 33(615)-2008)
(ARL-65-218; AD-626983) CFSTI: HC $2.00/MF $0.50

A high Mach number (M = 14) high Reynolds number (2×10^7/ft) facility was designed and built. This facility is capable of operating under a stagnation pressure of 30,000 p.s.i. and a stagnation temperature of 2500° R. A four second running time will be available with the present design; however, the possibility of obtaining higher running time may be accomplished by increasing the air storage system. The possibility of increasing the storage air temperature is also presently being investigated. Author (TAB)

N66-20838# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
HIGH TEMPERATURE FURNACE SYSTEM B-208-R
Robert C. Marshall, Charles E. Ryan, Dennis P. Considine, and John J. Hawley Oct. 1965 35 p refs *Its* Instrumentation papers no. 85
(AFCRL-65-748; AD-626168) CFSTI: HC $2.00/MF $0.50

The report describes the design, installation, calibration and test of one of the high temperature crystal growing furnace systems of the Solid State Sciences Laboratory of the Air Force Cambridge Research Laboratories. A number of the modifications and innovations that make this system unique are described. Pictures and diagrams of the furnace and associated apparatus and component specifications are sufficiently complete to provide substantial aid in the operation or duplication of this facility. The furnace has been operated above 2800° C for short periods of time (hours) and above 2000°C for extended periods (days). It has been in operation for over a year and more than 50 separate experiments have been conducted. Author (TAB)

N66-20894*# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
ACCEPTANCE CHECKOUT EQUIPMENT—SPACECRAFT Monthly Progress Report, 15 Jan.-15 Feb. 1966
J. F. Stafford and L. M. Downes 1 Mar. 1966 29 p refs
(Contract NASw-410)
(NASA-CR-71168) CFSTI: HC $2.00/MF $0.50 CSCL 22D

Acceptance test activities during the period January 15 through February 15, 1966, included spacecrafts 011 and 008 checkouts; completion of the ACE-S/C interleaver validation; a spacecraft 009 countdown demonstration test; and a flight readiness tests with two ground stations operating downlink in parallel. G.G.

N66-20914# Congress. House. Committee on Government Operations.
MISSILE AND SPACE GROUND SUPPORT OPERATIONS
Washington, GPO, 1966 182 p Hearings before Subcomm. of the Comm. on Govt. Operations, 289th Congr., 2d Sess., 25-27 Jan. 1966

The text of the hearings held by the Military Operations Subcommittee is presented. These concerned Defense Department and NASA ground operations in support of missile and space flight programs, with emphasis directed toward maximum joint use of facilities, standardization of equipment, integration of supplies, and effective advance planning. Testimony was also given on the developments related to the Manned

Orbital Laboratory, assigned to the Air Force, and to the Department of Defense program for satellite communications. Also included are documents pertaining to satellite communications services for Apollo, consolidated supply management at the DOD Eastern Test Range and the NASA Merritt Island Launch Area, agency responsibilities for management of co-located instrumentation facilities, and the responsibilities of the DOD manager for Manned Space Flight support operations. M.G.J.

N66-21032*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF OPERATING CHARACTERISTICS FOR AN ARC AIR HEATER USING DIRECT CURRENT AS OPPOSED TO HIGH-FREQUENCY ALTERNATING CURRENT
William L. Wells Washington, NASA, Apr. 1966 27 p refs
(NASA-TN-D-3358) CFSTI: HC $0.35/MF $0.50 CSCL 14B

Comparison tests at low pressures and enthalpies have been made with an arc air heater where in one case the power supply was a 3,000-cycle-per-second (hertz) single-phase alternator and in another case the power supply was a set of lead-acid cell batteries. The arc air heater used for the tests had water-cooled copper components and an arc gap of 0.25 inch (0.635 cm). The arc was stabilized and rotated around the electrodes by a separately excited magnetic field which was held constant at about 8,000 gauss (0.080 tesla). Arc chamber pressures were varied from about 46 to 118 psia (317 to 814 kN/m^2) with a resulting variation in air mass flow rates from about 0.007 to 0.029 lb/sec (3.18 to 131.8 g/sec), respectively. The power input to the arc covered the range from 80 to 125 kW for most of the test data. For comparable operating conditions, the operating efficiency (ratio of energy output to the energy input to the arc) of the high-frequency alternating-current system exceeded that of the direct-current system by at least 30 percent of the direct-current value. The highest efficiencies were obtained at the highest air flow rates in either case. When arc current values were nearly equal, the alternating-current and direct-current arc impedance values were about the same except when the direct-current arc shifted to a different mode of operation at low pressures. Author

N66-21055*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME VI: OPERATIONAL SUPPORT EQUIPMENT Study Report, Phase IA
30 Jul. 1965 623 p Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71477; TRW-5410-0006-RU-000) CFSTI: HC $9.23/MF $3.00 CSCL 22D

Functional descriptions are given of the operational support equipment required for the planned 1971 Voyager mission. The study was broken down into the following areas: objectives and criteria; design characteristics and restraints; system functional descriptions; subsystem functional descriptions; and implementation plans. Material and data are provided on possible alternate approaches, and to serve as a basis for the selected configurations of the support equipment. These configurations include: the system test complex for powering, monitoring, and recording during tests of the spacecraft; launch complex equipment for powering, monitoring, and recording during pre-flight tests; mission dependent equipment consisting of telemetry detectors, computer buffers, and command encoders, plus associated test equipment; and assembly, handling, and shipping equipment consisting of slings, hoists, dollies, transporters, and shipping containers. The data handling system, the mechanical alignment plan, and the advantages of the Voyager 1969 test for the development of support equipment for the 1971 mission are also discussed; and equipment design documents are presented. D.T.

N66-21060*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME IV: OPERATIONAL SUPPORT EQUIPMENT Final Technical Report, Phase IA Task B
17 Jan. 1966 297 p Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71480; TRW-5410-6001-RO-V04) CFSTI: HC $6.00/MF $1.50 CSCL 22D

This volume presents the approach to and functional descriptions of the major items of operational support equipment associated with all phases of assembly, testing, launch, and mission operations of the Voyager spacecraft. Discussions are included on objectives and design criteria, design characteristics and restraints, system and subsystem level functional descriptions, and schedules and an implementation plan. R.N.A.

N66-21068*# Boeing Co., Seattle, Wash. Aero-Space Div.
VOYAGER SPACECRAFT SYSTEM. VOLUME C: DESIGN FOR OPERATIONAL SUPPORT EQUIPMENT Final Technical Report
Jul. 1965 403 p Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71507; D2-82709-3) CFSTI: HC $7.03/MF $2.00 CSCL 22D

The Operational Support Equipment (OSE) necessary to support the Voyager mission is defined. Some of the more important OSE design features and guidelines that control the entire OSE design effort are described. They are: team concept, the use of common instrumentation and components throughout the various levels of mission hardware support, automation, maintainability and reliability, transportability, and safety. It is pointed out that these items form the backbone of the OSE design philosophy, and that implementation of this philosophy will result in operational support equipment that is effective, efficient, and available. R.R.D.

N66-21070*# Boeing Co., Seattle, Wash. Aero-Space Div.
VOYAGER SPACECRAFT SYSTEM. VOLUME E: DESIGN FOR OPERATIONAL SUPPORT EQUIPMENT—1969 TEST FLIGHT Final Technical Report
Jul. 1965 57 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71509; D2-82709-5) CFSTI: HC $3.00/MF $0.50 CSCL 22D

Operational Support Equipment (OSE) preliminary design data are presented for both the Atlas/Centaur launched 1969 test flight and the alternately proposed Saturn IB/Centaur launched 1969 test flight. The basic philosophy of the design of the OSE for the 1969 test flight includes the use of 1971 Voyager OSE with minimum modifications wherever practicable. The design of the OSE for the 1969 test flight is presented by noting the differences and exceptions to the design for the 1971 Voyager mission OSE. It is noted that the differences and exceptions which influence OSE design for the 1969 test flight are related to the fact that a science package and a flight capsule are not planned for the Atlas/Centaur launched test flight, and only simulated science packages and flight capsules are planned for the Saturn IB/Centaur launched test flight. R.R.D.

N66-21074*# Boeing Co., Seattle, Wash. Space Div.
VOYAGER SPACECRAFT SYSTEM. VOLUME B: DESIGN FOR THE OPERATIONAL SUPPORT EQUIPMENT Final Technical Report, Task B
Jan. 1966 433 p Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71511; D2-82709-7) CFSTI: HC $7.33/MF $2.25 CSCL 22D

The operational support equipment (OSE) design for the Voyager flight spacecraft is presented. The spacecraft system OSE includes the spacecraft bus subsystem OSE, the propulsion subsystem OSE, the government-furnished science subsystem OSE, the system test complex equipment that integrates appropriate elements of the spacecraft bus subsystem OSE with a central data and control system, the launch complex equipment, assembly, handling and shipping equipment, and mission dependent equipment and associated software. R.R.D.

N66-21080*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PRELIMINARY DESIGN, VOLUME A (BOOK 4A OF 4): FLIGHT SPACECRAFT PREFERRED DESIGN—IMPLEMENTATION PLANS
30 Jul. 1965 664 p refs Prepared for JPL *Its* Rept.-65SD4388
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71488) CFSTI: HC $9.64/MF $3.25 CSCL 22D

The Voyager schedule and implementation plan for the preferred flight spacecraft design is presented. The organization and objectives of the project management are outlined. Also discussed are the base line, hardware, operational support equipment, master milestone, and supporting schedules; the integrated test plan; Phase IB breadboard, engineering model development, and development spacecraft tests; and type approval and proof test model tests. Assembly and checkout, launch, and space flight operations are also described. The special test plan for the life test, and interface are discussed too. L.S.

N66-21085*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PRELIMINARY DESIGN, VOLUME C: 1971 OPERATIONAL SUPPORT EQUIPMENT DESIGN
30 Jul. 1965 660 p refs Prepared for JPL *Its* Rept.-65SD4388
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71493) CFSTI: HC $9.60/MF $3.00 CSCL 22D

Design criteria, testing, and description of the System Test Complex; Launch Complex; Mission Dependent; and Assembly, Handling, and Shipping Equipment necessary for support of the Voyager 1971 test and evaluation program are presented. The above equipment comes under the heading of Operation Support Equipment, OSE. Radio, power, data storage and encoder, attitude control and approach guidance, pyrotechnics, command verification, telemetry, and other equipment and systems are discussed. Tables of data, and block diagrams are included with the report. Also discussed are the basic system test approach and philosophy, deployable element testing, and the use of computers in the System Test Complex. L.S.

N66-21087*# General Electric Co., Philadelphia, Pa.
VOYAGER SPACECRAFT SYSTEM: PRELIMINARY DESIGN, 1969 OPERATIONAL SUPPORT EQUIPMENT DESIGN, VOLUME E
30 Jul. 1965 58 p Prepared for JPL
(Contracts NAS7-100; PL-951112)
(NASA-CR-71495; DIN-65SD4388, Vol. E) CFSTI: HC $3.00/MF $0.50 CSCL 22D

Functional descriptions of the operational support equipment (OSE) recommended for the 1969 Voyager spacecraft are presented. The test objectives and design criteria are defined for the system test complex (STC), the launch complex equipment (LCE), mission dependent equipment (MDE), and the assembly, handling and shipping equipment (AHSE). Design characteristics and restraints are also given. The data cover: (1) the STC test conductor's console, required power and distribution, printers and displays used by the computer data system, the OSE power and pyrotechnic subsystems, the OSE data encoder and storage, and the STC and LCE umbilical simulator; (2) the LCE pyrotechnic test kit, and OSE power system and pyrotechnic subsystem; (3) the MDE capsule radio simulator, and the hardware and software required in the deep space network; and (4) assembly, handling, and interface fixtures, alignment equipment, handling fixtures and ground transporter, and shipping containers. M.G.J.

N66-21091*# General Electric Co., Philadelphia, Pa.
VOYAGER SPACECRAFT SYSTEM, PHASE IA, TASK B: PRELIMINARY DESIGN. OSE FUNCTIONAL DESCRIPTION, VOLUME B
31 Jan. 1966 259 p Prepared for JPL
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71499; DIN-65SD4514, Vol. B) CFSTI: HC $6.00/MF $1.50 CSCL 22D

Data for the preliminary design of Voyager spacecraft systems and subsystems are presented. Functional descriptions of the Operational Support Equipment (OSE) recommended for the revised 1971 Voyager spacecraft are summarized. Discussions of objectives and design criteria and of design characteristics and restraints are presented. Functional descriptions are outlined for the System Test Complex (STC), Launch Complex Equipment (LCE), Assembly, Handling, and Shipping Equipment (AHSE), and other systems required to support the spacecraft during prelaunch and launch activities. M.R.W.

N66-21093*# Arde-Portland, Inc., Paramus, N. J.
A STUDY OF THE OPTIMUM USE OF LAND EXPOSED TO AIRCRAFT LANDING AND TAKEOFF NOISE
Washington, NASA, Mar. 1966 146 p refs
(Contract NAS1-3697)
(NASA-CR-410) CFSTI: HC $1.80/MF $1.00 CSCL 01E

This report considers methods of alleviating the airport community noise problem by supplying guide lines for land use and building practices in noise affected areas near airports to reduce the area's sensitivity to noise. The report examines the legal, economic, and administrative aspects of such guidance. The report also considers the costs, technical possibilities, and limitations of noise-proof building construction to relieve the noise problem. Actions by airport authorities in dealing with property owners in noise affected areas are reviewed. Procedures are presented for estimating the expected noise exposure around airports based on projected flight schedules. Desirable land uses near airports are defined and listed. A hypothetical airport community situation is analyzed to show, by example, how the various land use control and building noise proofing techniques can be applied, and the cost of such application. The important elements of several significant law cases concerning noise affecting properties near airports are summarized. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-19823# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE METHOD OF TRANSVERSE APPROXIMATION IN A HYPERSONIC FLOW
I. I. Aleksenko, R. G. Barantsev, and I. N. Panteleyeva 6 Jan. 1966 34 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 4, 1962 p 62-78
(FTD-TT-65-1806/1+2+4; AD-626968) CFSTI: HC $2.00/MF $0.50

The direct problem of hypersonic flow about blunt nose bodies is solved by the method of a priori Ansatz of stream function dependence upon the transversal coordinate counted along the normal to the shock wave. The case of the linear approximation is considered in detail. Author (TAB)

N66-19848# California Inst. of Tech., Pasadena. Hydrodynamics Lab.
HYDRODYNAMICS OF TURBOMACHINES Final Report
Allan J. Acosta Nov. 1965 15 p refs
(Contract Nonr-220(24))
(Rept.-79.9; AD-625418) CFSTI: HC $1.00/MF $0.50

The principal objective was to understand the basic features of the flow in various types of turbomachines and where possible to use such results in the development of design theories. The major emphasis was placed upon problems of cavitation in axial machines and certain theoretical as well as experimentally related phenomena. Three projects were undertaken: The measurement and observation of cavitating flows in axial inducer pumps, the observation of cavitation and cavitation inception in fluids other than water, and the observation and measurement of forces on the vanes of a cavitating cascade in a water tunnel. Author (TAB)

N66-19892# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF FLOW BOUNDARIES UPON CAVITY FLOW AROUND A CYLINDER
K. K. Shal'nev 11 Jan. 1966 18 p refs Transl. into ENGLISH from Zh. Prik. Mikhan. i Tekhn. Fiz. (Moscow), no. 3, 1965 p 103-108
(FTD-TT-65-1813/1+2+4; AD-626973) CFSTI: HC $1.00/MF $0.50

The reduction of experimental data characterizing cavity flow-around of a cylinder in a straight working chamber of a hydrodynamic tube to conditions of flow-around by a flow of infinite width with the help of the equivalent velocity found from the equation of continuity can lead to errors in determining these parameters. The cause of these errors is that the increment of equivalent velocity along the profile of the model of a cylinder is nonuniform and, besides the effect of the flow boundaries, it is also subjected to the effect of the stage of cavitation development, i.e., to changes in the form and dimensions of the cavitation zone depending upon the cavitation number. The true magnitude of the correction can be determined only as a result of a series of tests with different constriction of the flow by the models at identical Reynolds numbers and cavitation stages by the method of extrapolation. Author (TAB)

N66-19935# Kyushu Univ., Fukuoka-Ken (Japan).
REPORTS OF RESEARCH INSTITUTE FOR APPLIED MECHANICS, VOLUME III, NUMBER 45
1965 65 p refs
CFSTI: HC $3.00/MF $0.75

CONTENTS:

1. STABILITY OF LAMINAR SHEAR LAYER BETWEEN PARALLEL UNIFORM STREAMS (II) H. Yamada p 1–15 refs (See N66-19936 10-12)
2. EQUIPMENT FOR MEASURING SIX MOTIONS OF A SHIP MODEL F. Tasai, M. Kaname, and H. Arakawa p 17–23 refs (See N66-19937 10-14)
3. SHIP MOTIONS IN BEAM SEAS F. Tasai p 25–59 refs

N66-19936 Kyushu Univ., Fukuoka-Ken (Japan).
STABILITY OF LAMINAR SHEAR LAYER BETWEEN PARALLEL UNIFORM STREAMS
Hikoji Yamada *In its* Repts. of Res. Inst. for Appl. Mech. 1965 p 1–15 refs (See N66-19935 10-12) CFSTI: HC $3.00/MF $0.75

In the former half the Orr-Sommerfeld equation of a shear layer between parallel uniform streams has been solved in a certain series of Hermite functions. The non-dimensional lateral distance y is replaced by $\eta=\alpha y$, where α is the wave number of perturbation waves, because neutral oscillation expressed in η extends quite evenly over only neighboring area of x-axis. Thus with first several terms of series the approximation is found to be good enough from $\alpha=0(R=0)$ to $\alpha\fallingdotseq 1(R=\infty)$. In the latter half the wall effect to the neutral stability when the Reynolds number is quite small has been discussed, for then the disturbance waves are of small wave number and extend up to walls. In this case the shear layer has been replaced by a discontinuous surface of velocity which simplified very much the analysis. Author

N66-19959# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYMPOSIUM ON FLUID MECHANICS
Yu-Ch'ang Li 6 Jan. 1966 5 p Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 3, 1964 p 273
(FTD-TT-65-691/1+2+3+4; AD-626951) CFSTI: HC $1.00/MF $0.50

A brief summary is given of topics presented at the symposium which was held in Shanghai in October, 1963. TAB

N66-19977# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics and Engineering Sciences.
PROBLEMS IN NONLINEAR VISCOELASTICITY
Severino L. Koh Sep. 1965 69 p refs
(Contract Nonr-1100(23))
(TR-31; AD-626201) CFSTI: HC $3.00/MF $0.75

Several nonlinear constitutive relations proposed by different investigators are briefly reviewed and an enumeration is given of the other fundamental equations needed in the analysis of specific problems. Among the problems discussed are steady flow of nonlinear viscoelastic fluids, periodic motion, wave propagation and thermomechanical coupled effects. Author (TAB)

N66-19978# Itek Corp., Palo Alto, Calif. Vidya Div.
CALCULATION OF LAMINAR SEPARATION WITH FREE INTERACTION BY THE METHOD OF INTEGRAL RELATIONS. PART I: TWO-DIMENSIONAL SUPERSONIC ADIABATIC FLOW Technical Documentary Report, Mar. 1964–May 1965
Jack N. Nielsen, Larry L. Lynes, and Frederick K. Goodwin Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., Oct. 1965 121 p refs
(Contract AF 33(615)-1591)
(VIDYA-185; AFFDL-TR-65-107; AD-626160) CFSTI: HC $4.00/MF $0.75

Methods are presented for calculating the laminar boundary-layer flow through separation to reattachment under the influence of a prescribed pressure gradient or, in the case of a supersonic main stream, under the influence of 'free interaction' between the boundary layer and the main flow. The present method is based on the Dorodnitsyn method of integral relations and uses a rational velocity profile which accounts properly for the separation singularity. As a result, the possibility of higher approximations is inherent in the method. The calculated solution for free interaction goes smoothly through the separation point and is in good agreement with certain features of the Navier-Stokes solution in the neighborhood of separation. Good agreement is exhibited between experimental and calculated pressure distributions up to reattachment for the several cases for which the comparisons were made. A computer program based on the work was prepared for two-dimensional flow. It is planned to continue the work to cover nonadiabatic boundary layers and axisymmetric bodies.
Author (TAB)

N66-19986# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOMENT OF RESISTANCE TO ROTATION OF AN ENCLOSED DISC
V. S. Sedach 6 Jan. 1966 19 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 4, 1961 p 66-74
(FTD-TT-65-1809/1+2+4; AD-626971) CFSTI: HC $1.00/MF $0.50

The hydrodynamics of flow in axial clearances between the rotating disk and the housing wall in turbomachines was studied. The effects of the width of the cylindrical wall of the housing, the width of the disk rim, as well as the radial clearance between the housing and the disk were included by analyzing experimental data on the kinematics of flow. It was found that the velocity of disk rotation, the regime of flow, and the relationship of the geometric parameters of the flow boundaries in the clearances have an effect on the average angular rotation velocity of the flow nucleus. In addition, formulas are given for determining the average angular velocity of the flow nucleus and the moment of resistance to rotation of a smooth disk of constant thickness within a cylindrical housing.
H.S.W.

N66-20060# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
EFFECT OF THE REYNOLDS NUMBER AND THE BOUNDARY LAYER THICKNESS ON THE BASE PRESSURE ON WEDGE FLOWS [EINFLUSS DER REYNOLDSZAHL UND DER GRENZSCHICHTDICKE AUF DEN TOTWASSERDRUCK BEI DER UMSTROMUNG VON KEILEN]
M. Tanner May 1965 41 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-18; AVA-FB-65-04) CFSTI: HC $2.00/MF $0.50

A report is presented of wind tunnel measurements on wedges in incompressible two-dimensional flow which are performed to explain the effect of the Reynolds number and the boundary layer thickness on the base pressure. The results show that the base pressure is independent of the Reynolds number but increases to some extent with increasing boundary layer thickness.
Author

N66-20065# Royal Aircraft Establishment, Farnborough (England).
EXPERIMENTS ON THE AXI-SYMMETRIC FLOW OVER AFTERBODIES AND BASES AT M=210
J. Reid and R. C. Hastings London, Min. of Aviation, Oct. 1959 76 p refs
(RAE-AERO-2628)

The effects of profile shape and boundary-layer growth on the side and base pressures of an axi-symmetric afterbody are investigated. The tests were made at M=2 with a turbulent boundary-layer on a cylinder, three truncated cones and three truncated parabolae. Firstly, the boundary-layer profile was measured at the shoulder and base of each of the conical and parabolic afterbodies, and the growth of the layer was traced along the cylinder and the shortest parabola. Secondly, the pressure was measured along each of the conical and parabolic afterbodies. Thirdly, the effect of boundary-layer thickness on the base pressure of the cylinder, and afterbody angle on the base pressure of the cones and parabolae were investigated. Supplementary tests with the cylinder show the axial pressure distribution behind the base, and also the effect of a sting or an external disturbance on the base pressure. The boundary-layer data are compared with two theoretical methods of calculating boundary-layer growth; the afterbody pressures are compared with the theoretical distributions in inviscid flow, and the effect of afterbody angle on the base pressure is compared with two semi-empirical methods of correlation.
Author

N66-20109# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE SYSTEM OF EQUATIONS OF THE LAMINARY BOUNDARY LAYER IN A COMPRESSIBLE GAS NEAR THE STAGNATION LINE
B. N. Reznikov and Yu. N. Smyslov 3 Jan. 1966 12 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 3, 1965 p 85–88
(FTD-TT-65-1773/1+4; AD-627126) CFSTI: HC $1.00/MF $0.50

A system of equations relative to the friction and the heat flux is derived so that the precise values do not depend on the magnitude of the injection parameter into the boundary layer. The precision of the unknown values is established by evaluating the successive terms of the asymptotic expansion. Functions for the flow around a flat critical point by a compressible gas are given. An asymptotic expansion and numerical integration are also given, and an analysis of the values from the two methods is presented. It is concluded that the asymptotic approximations of the friction and heat flux values are sufficiently accurate.
N.E.N.

N66-20110# Pennsylvania State Univ., University Park. Ordnance Research Lab.
THE LAMINAR BOUNDARY LAYER IN THE VICINITY OF A SUCTION SLOT
C. F. Holt Dec. 1965 69 p refs
(Contract NOw-65-0123-d)
(TM-502.2421-12; AD-627025) CFSTI: HC $3.00/MF $0.75

The interest in suction as a means of controlling the growth of the laminar boundary layer has led to the investigation of the behavior of such a boundary layer in the vicinity of a discrete suction slot. In order to observe the effect of one such slot, detailed boundary layer profiles were measured at various stations upstream and downstream of a slot. The investigation was carried out for the three slot Reynolds numbers equal to 29, 186, and 366. At each Reynolds number slot widths of 1/16, 3/32, and 1/8 inch were tested. Variation in the displacement thickness, momentum thickness and a shape factor based on the ratio of these two parameters indicated that the slot affects a region from 20 to 30 times its own width and introduces substantial changes in the aforementioned variables. In the present tests suction created profiles after the slot with shape factors equal to or less than the asymptotic suction value. Author (TAB)

N66-20157# Picatinny Arsenal, Dover, N. J.
ON THE ANALOGY BETWEEN A CYLINDRICAL SHOCK AND THE HYPERSONIC FLOW OF GAS PAST A BODY
V. P. Korobeynikov Jan. 1966 13 p refs Transl. into ENGLISH from Probl. Mat. i Teor. Fiz. (USSR), no. 6, 1962 p 45–49
(PA-TT-3; AD-627165) CFSTI: HC $1.00/MF $0.50

It is known that the results of the solution of the problem of a cylindrical point shock in a gas may be used for the approximation of a number of flow characteristics in the stationary hypersonic flow of gas past thin blunt-nosed objects. Previous works compared the results of shock theory with calculations made on the problem of flow past a blunt-nosed cylinder for the case of a self-similar shock without taking account of back pressure or with the linearized shock problem allowing for back pressure. The article outlines an approximate method of determining the law of motion of a shock wave and the pressure in the center of the shock; these computations for flow problems are compared. Author

N66-20186# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INVESTIGATION OF THE THREE-DIMENSIONAL SUPERSONIC FLOW AROUND ELLIPSOIDS OF REVOLUTION
G. P. Tiniakov [1965] 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1965 p 10-19

Computations on the flow around ellipsoids of revolution with a detached shock were obtained by analyzing the subsonic and supersonic regions in a steady-state three-dimensional supersonic perfect gas flow around a blunt body. A coordinate system based on a spherical system with center and axis disposed arbitrarily relative to the body was used to approximate the character of the parameter distribution for each group of problems, the selection of the position of the center, and the inclination of the axis so that the maximum approximation accuracy was achieved in the whole domain under consideration for a fixed number of space rays. This extension of a two-dimensional problem to the case of three variables resulted in less than 1.5% relative error, with the greatest parameter error in the region of the sonic line. G.G.

N66-20204# Case Inst. of Tech., Cleveland, Ohio. Engineering Div.
THE VISCOMETRIC FLOW OF A GAS NEAR ITS CRITICAL POINT
Robert A. Naftzger and Jerzy R. Moszynski Jun. 1965 66 p refs
(FTAS/TR-65-5)

In recent measurements of the viscosity of CO_2 made with a capillary viscometer, an anomalous peak in the viscosity of the gas near its critical point has been observed. In an effort to explain the presence of this peak, the effect of the compressibility of a fluid upon the determination of its viscosity is investigated for flow in a narrow channel, as well as a capillary. The fluid is assumed to be linear and the flow, steady and isothermal. For the flow in the channel the influence of the compressibility upon the determination of the viscosity is found, and the convective acceleration or expansion of the fluid is shown to be the major compressibility effect. In the case of the capillary the analysis is limited to the measurements of the viscosity of CO_2 in question. The results of the analysis show that the effect of the compressibility of the gas is negligible and cannot serve to explain the peak in viscosity observed. Author

N66-20255# California Univ., Berkeley. Lawrence Radiation Lab.
AN EXPERIMENTAL STUDY OF NON-EQUIMOLAL DIFFUSION IN TERNARY GAS MIXTURES
R. W. Getzinger and C. R. Wilke Apr. 1964 15 p refs
(Contract W-7405-ENG-48)
(UCRL-9987, Rev. 2) CFSTI: HC $1.00/MF $0.50

Diffusion measurements using the Stefan capillary tube method were carried out in three ternary gas systems at 35°C. These systems comprised $CH_3OH-C_6H_6$, $CH_3OH-CCl_4$, and $C_2H_5OH-CHCl_3$ diffusing into stagnant air. The experimental results were compared with calculations from the Stefan–Maxwell equations. NSA

N66-20270# Sandia Corp., Albuquerque, N. Mex.
NUMERICAL SOLUTION OF SOME PROBLEMS OF GAS FLOWS [CHISLENNOE RESHENIE NEKOTORYKH ZADACH O TECHENIYAKH GAZA]
P. I. Chushkin 24 Aug. 1965 28 p refs Translated into ENGLISH from Arch. Mech. Stosowanej (Warsaw), v. 16, no. 3, 1964 p 577-596
(SC-T-65-756) CFSTI: HC $2.00/MF $0.50

Numerical solutions are presented for the following problems: potential flow in the subsonic and transonic portion of the Laval jet, unstable one dimensional flow during an explosion in a gas, circumfluence of blunt bodies by hypersonic flow in a magnetic field, and a method for characteristics on the basis of strata. NSA

N66-20288# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering.
[CRITICAL FLOW OF LIQUID METALS]
H. S. Isbin 15 Jan. 1965 16 p ref
(Contract AT(11-1)-926)
(COO-926-33) CFSTI: HC $1.00/MF $0.50

Graphs are given which show the application of the Moody model for estimating the critical (two-phase) flow rates of the liquid metals Cs, Na, K, Li, Rb, and Hg. The Moody and Fauske models are discussed, and equations are given. NSA

N66-20314# Commissariat a l'Energie Atomique, Saclay (France).
GRAPHITE SUSPENSION IN CARBON DIOXIDE [SUSPENSION DE GRAPHITE DANS LE GAZ CARBONIQUE]
Roland Roche, Claude Moussez, Xavier Rouvillois, and Roland Brevet Jan. 1963 37 p refs In FRENCH
(CEA-R-2741)

Experimental work with a two-component fluid comprised of carbon dioxide and small graphite particles was made for the determination of basic engineering information pertaining to the stability and the flowability of the suspension. The final form of the experimental loop consists mainly of the following items: a light-phase compressor, a heavy-phase pump, an electrical-resistance type heater section, a cooling heat exchanger, a hairpin loop, a transparent test section, and a separator. During the course of the testing, it was observed that the fluid could be circulated quite easily in a broad range of variation of the suspension density and velocity—density from 30 to 170 kg/m 3 and velocity from 2 to 24 m/sec. The system could be restarted and circulation maintained without any difficulty, even with the heavy-phase pump alone. The graphite did not have a tendency to pack or agglomerate during operation. No graphite desposition was observed on the wall of the tubing. A long period run (250 hours) showed the evolution of the particle dimensions. Starting with graphite of surface area around 20 m^2/g (graphite particles about 1 μ), the powder surface area reached an asymptotic value of 300 m^2/g (all the particles less than 0.3 μ). Moisture effect on flow stability, flow distribution between two parallel channels, pressure drop in straight tubes, recompression ratio in diffusers were also investigated. Author (NSA)

N66-20334# California Univ., Livermore. Lawrence Radiation Lab.
SIMILARITY SOLUTIONS IN 1-D HYDRODYNAMICS
R. Grover 28 Aug. 1964 49 p refs
(Contract W-7405-ENG-48)
(UCRL-12018-T) CFSTI: HC $2.00/MF $0.50

A summary of the theory of similarity solutions in one-dimensional hydrodynamics is given in which the limiting role of the equation-of-state is emphasized. A description of a digital computer code (SIMS) for calculating the similarity solutions of a γ-law fluid is given. Two new examples of similarity solutions are described. Author (NSA)

N66-20459# Case Inst. of Tech., Cleveland, Ohio. Nuclear Physics Lab.
PAIR CORRELATION FUNCTIONS IN CLASSICAL STATISTICAL MECHANICS
Frank Alden Blood, Jr. Nov. 1965 146 p refs *Its* Tech. Rept.-53)
(Contract AT(11-1)-720)
(COO-720-053) CFSTI: HC $4.00/MF $1.00

Properties of the pair correlation function for a classical fluid, in equilibrium, having a symmetric potential, are investigated. It is shown that the 3-particle density function for the fluid can be expressed in terms of the pair correlation function. The ideas of the hypernetted chain theory can be used to express the potential as an explicit, although very complicated, functional of the radial distribution function. An approximation of this equation, together with another equation from the hypernetted chain theory, gives the Percus–Yevick equation. The possibility of solving for the pair potential when given the pair correlation function is investigated for seven cases. Author (NSA)

N66-20527# Los Alamos Scientific Lab., N. Mex.
THE TWO-DIMENSIONAL HYDRODYNAMIC HOT SPOT, VOLUME II
Charles L. Mader 3 Apr. 1965 127 p refs
(Contract W-7405-ENG-36)
(LA-3235) CFSTI: HC $4.00/MF $0.75

The basic processes in the shock initiation of inhomogeneous explosive are investigated theoretically using the model of a cylinder of nitromethane containing either a cylindrical or a biconical void, or a sphere or cylinder of aluminum. The interaction of a shock with these density discontinuities, the resulting formation of a hot spot, and the buildup to propagating detonation are computed using two-dimensional numerical hydrodynamics of the PIC type. For the aluminum density discontinuities, the calculations exhibit failure or propagation of detonation from the hot spot in approximately the same manner as does the one-dimensional hydrodynamic hot spot model. The interaction of a shock with corners of aluminum and Plexiglas in nitromethane is discussed. Radiographs of a shock interacting with a spherical bubble in water are compared with theoretical calculations and confirm the validity of the computations. Author (NSA)

N66-20585# Ohio State Univ. Research Foundation, Columbus.
SIMILITUDE FOR NORMAL SHOCK WAVES IN NON-EQUILIBRIUM FLOWS Interim Technical Report No. 5
R. E. Thomas, D. Brooke, and S. L. Petrie Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., Oct. 1965 49 p refs
(Contract AF 33(657)-10416)
(AFFDL-TR-65-91; AD-627031) CFSTI: HC $2.00/MF $0.50

Similarity parameters are developed which govern the length of nonequilibrium zones behind normal shock waves. Nonequilibrium effects produced by both vibrational relaxation and dissociation are considered. The parameters can also account for arbitrary level of free-stream vibrational energy or dissociation level. The validity of the parameters is examined using numerical computations of the properties of the nonequilibrium fields. These computations are made with the aid of experimentally based rate expressions. The parameters, when written in a form describing the variation of nonequilibrium zone length with Mach number, are shown to have acceptable accuracy. Author (TAB)

N66-20652# Technische Hogeschool, Eindhoven (Netherlands).
A STUDY OF THE APPLICATION OF ACOUSTICAL METHODS FOR DETERMINING VOID FRACTIONS IN BOILING WATER SYSTEMS
F. v. d. Walle, A. J. Verheugen, V. J. M. Haagh (Rescona N. V., Amstelveen), and M. Bogaardt Brussels, EURATOM, Feb. 1966 32 p refs Presented at the Symp. on Two-Phase Flow, Exeter, England, 20–23 Jun. 1965 Prepared in cooperation with Rescona N. V., Amstelveen
(Contract EURATOM-030-64-1 TEEN)
(EUR 2336.e) CFSTI: HC $2.00/MF $0.50

A survey has been given of the acoustical properties of liquid gas bubble mixtures. The available theory has been extended to the case of liquid vapor bubble mixtures. Expressions for speed of sound and damping have been derived and numerical values have been calculated. It is shown that it is possible in principle to determine volume fraction of vapor and bubble size distribution from measurements of speed of sound and damping in a mixture as a function of frequency. The method is especially for small void ratio's. Some simple experiments have been started in an air–water mixture. Author

N66-20677# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.
BOUNDARY LAYER SEPARATION IN INTERNAL FLOW
Hal L. Moses, John R. Chappell, and Tomas Goldberger Sep. 1965 61 p refs
(Contract Nonr-1841(91))
(Rept.-81; AD-627428) CFSTI: HC $3.00/MF $0.75

An investigation of incompressible turbulent boundary layer separation in internal flow is presented with experimental results for a variable geometry, two-dimensional diffuser and two conical diffusers. A simple analytical model is adopted, which consists of wall boundary layers and a one-dimensional, inviscid core. Several approximate boundary layer methods and the possibility of extending them into the separated region are examined. With a limited amount of separated flow, the calculated pressure agrees reasonably well with the experimental results and gives a fair indication of maximum diffuser performance. The limitations of the model to the more general problem, as well as the problem of singularities and downstream stability, are discussed. Author (TAB)

N66-20813# Western Co. of North America, Dallas, Tex. Research Div.
EFFECT OF MOLECULAR WEIGHT AND SEGMENTAL CONSTITUTION ON THE DRAG REDUCTION OF WATER SOLUBLE POLYMERS Final Report
Gail T. Pruitt and Horace R. Crawford Apr. 1965 125 p refs
(Contract Nonr-4306(00))
(DTMB-1; AD-625801) CFSTI: HC $4.00/MF $0.75

Tube flow data on some 16 polymers indicate that drag reduction is a function of molecular contour length, segmental side groups, concentration, pipe diameter and Reynolds number. The maximum drag reduction actually obtained with any drag reducing polymer is approximately 80% of that which would be obtained if completely laminar flow was maintained. A relationship that correlates drag reduction, concentration and molecular dimensions is suggested for a constant Reynolds number and pipe size. It infers that a critical concentration of polymer exists, below which no drag reduction occurs. Also for some given concentrations and pipe size a critical velocity exists below which no drag reduction occurs. Rheological data for two polymer solutions are presented in terms of elastic energy. Author (TAB)

N66-20815# David Taylor Model Basin, Washington, D. C.
THE EFFECT OF DISTORTION OF SUB-CAVITATING FOIL CONTOURS ON CAVITATION INCEPTION VELOCITY
George P. Moeckel Oct. 1965 38 p refs
(AD-625864) CFSTI: HC $2.00/MF $0.50

The purpose of the paper is to investigate the theoretical effect of distortions on subcavitating foil sections in regard to cavitation inception velocities. The study is intended to give some prediction as to type and size of distortions that may be tolerated in foil construction. It is natural to expect errors in foil shape to occur as a result of inaccurate construction or damage. It is therefore the intention of this paper to provide estimates of admissible deviations from the intended foil geometry in order that cavitation may be prevented or at least anticipated. Author (TAB)

N66-20822# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
A STUDY OF TURBULENT FLOW IN ROUGH PIPES
J. M. Robertson, T. H. Burkhart, and J. D. Martin May 1965 142 p refs
(Contract Nonr-1834(32))
(TEAM-279; AD-625037) CFSTI: HC $4.00/MF $1.00

The considerable literature on turbulent flow past rough surfaces is correlated in terms of modes of presenting the smooth-to-rough transition and the influences of roughness density and shape. Flow measurements in a 3 in. smooth and sand roughened pipe and in an 8 in. steel pipe with 'natural' roughness are reported. The temporal-mean velocity and friction measurements show transitional (between smooth and fully rough behavior) variations. The pipe factor variation is also elucidated; the sand-roughened pipe studies indicate a shift in Nikuradse's presentation. The turbulence—as intensity divided by shear velocity and macroscale in ratio to pipe radius—in rough pipe flow appears the same in rough as in smooth pipe flow. The relative turbulence intensity is constant, or at most decreases slowly with increase in flow Reynolds number. Author (TAB)

N66-20835# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE INTERACTION OF TURBULENCE WITH RAPID UNIFORM SHEAR
H. K. Moffatt Aug. 1965 41 p refs
(Contract AF 49(638)-1274)
(SUDAER-242; AFOSR-65-1795; AD-626298) CFSTI: HC $2.00/MF $0.50

The linear inviscid response of an initially weak random velocity perturbation to a uniform shearing motion is analyzed, first in terms of the individual Fourier components of the perturbation field, then in terms of the development of its spectrum tensor. This analysis reveals that the dominant contribution, both to the disturbance energy and to the Reynolds stress generated, comes ultimately from eddies having a cylindrical structure, the axes of the cylinders being parallel to the shear force. The results are relevant to two aspects of turbulent shear flow: (1) the equilibrium structure of a small turbulent parcel of fluid subjected to persistent almost uniform shear, and (2) the structure of the large eddies which derive their energy directly from the shearing of the mean flow. Certain aspects of the distortion of turbulence by shear that is weakly non-uniform are also considered, and it is found that the gradient in the Reynolds stress generated tends to make the mean velocity profile propagate elastically as a shear wave, suggesting that in certain respects turbulent fluid behaves like a visco-elastic fluid in its response to shear. Finally, the relevance of these results to the phenomenon of the propagation of sharp turbulent-nonturbulent interfaces is discussed. Author (TAB)

N66-20889*# California Univ., La Jolla.
LAMINAR BOUNDARY LAYER ON A CONE WITH UNIFORM INJECTION
Paul A. Libby [1965] 16 p ref
(Grant NGR-05-009-025)
(NASA-CR-71158) CFSTI: HC $1.00/MF $0.50 CSCL 20D

A solution for the laminar boundary layer on a cone with uniform mass transfer is obtained. The velocity field is found for either suction or injection but the related solution for the energy field is subject to an energy balance at the exposed surface and is therefore valid only for injection. This latter solution is equally applicable to certain species fields as well. The present results along with those presented previously for the two-dimensional case permit a comparison of the effect of injection on boundary layers over two-dimensional and conical surfaces. Author

N66-20911# California Univ., Los Angeles. Dept. of Engineering.
A STUDY OF SOME ASPECTS OF JET FLOWS AND EDGE-TONES
Madan M. Oberai Nov. 1965 27 p refs
(Contract Nonr-233(62))
(Rept.-65 50; AD-625086)

The study concerns the phenomenon of edge-tones and of those aspects of jet-flows that are relevant to the study of edge-tones. The object of the report is to present, in a synthetic form, the results of some important classical and recent works on the subject with a view to facilitate further research in this field. A few comments are added on certain points that need attention of researchers in this area. Author (TAB)

N66-20917# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
A TIME DEPENDENT LAMINAR FLOW
F. L. Fuller Dec. 1965 34 p ref
(RM-306)

A mathematical solution with numerical evaluation is given for the one dimensional heat equation with special boundary conditions. Its application is in solving a time-dependent laminar incompressible fluid flow problem in which there is a transition from slug flow to Poiseuille flow. The average flow rate is at all times assumed to have a given fixed value. Author

N66-20940*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATIVISTIC CHARGED FLUID FLOW. III: GENERALIZED HAMILTON-JACOBI EQUATION
Lawrence A. Schmid Jan. 1966 43 p refs
(NASA-TM-X-55430; X-641-66-8) CFSTI: HC $2.00/MF $0.50 CSCL 20D

When the forces resulting from viscosity and heat injection are described in terms of the thermal 4-potential, it is possible to derive a scalar equation of motion that has the form of a generalized Hamilton-Jacobi equation. The formalism employs a generalization of the canonical particle momentum that includes the thermal 4-potential as well as the electromagnetic 4-potential. This generalized canonical momentum can be represented by means of a generalized Clebsch transformation. One of these scalar functions is Hamilton's characteristic function, which is the unknown in the generalized Hamilton-Jacobi equation. The other two functions determine the intrinsic vorticity of the fluid, which is defined as the curl of the generalized canonical momentum and which, according to the generalized Larmor theorem, is to be associated with that part of the fluid rotation that is a residual of the initial conditions of the fluid. In the case of adiabatic flow, it is possible to express the thermal 4-potential in terms of the specific entropy and the temperature integral, which is defined as the scalar function whose substantial time derivative is equal to the temperature. Author

N66-21042*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF LAX'S FINITE-DIFFERENCE METHOD TO NONEQUILIBRIUM HYPERSONIC FLOW PROBLEMS
Fred R. De Jarnette Washington, NASA, Mar. 1966 45 p refs
(NASA-TR-R-234) CFSTI: HC $0.65/MF $0.50 CSCL 01A

The finite-difference method developed by P. D. Lax for unsteady flows is applied to the steady-state equations for the supersonic region of inviscid flows past two-dimensional and axisymmetric bodies. A diatomic gas subject to nonequilibrium vibrations and dissociation is considered. As a consequence of Lax's finite-difference scheme, an artificial viscosity is implicitly introduced. This scheme allows the computations to proceed downstream of an initial data line as if no shock wave were present at all. The shock wave appears in the solution, however, smeared over several mesh spaces while it accurately gives the proper jump conditions across the shock. A new difference scheme is developed for the body points that is more accurate than previously used extrapolation schemes and reflection principles. The numerical results of the present method are shown to compare favorably with the methods of characteristics and integral relations for frozen flow over a cone–parabolic-arc–cylinder, vibrational nonequilibrium flow over a wedge, and chemical nonequilibrium flow of Lighthill's "ideal dissociating gas" over a wedge. Author

N66-21101*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DATA ON EFFECTS OF INCIDENT-REFLECTORY SHOCK ON THE TURBULENT BOUNDARY LAYER
S. Z. Pinckney Washington, NASA, Mar. 1966 209 p refs
(NASA-TM-X-1221) CFSTI: HC $2.30/MF $1.25 CSCL 20D

An experimental investigation was conducted to study the effect of the impingement of an incident-reflecting shock on the development of a turbulent boundary layer. The data are presented in the form of shadowgraphs and schlieren photographs of the shock-boundary-layer interaction region, boundary-layer Mach number and velocity profiles, and static-pressure and wall-temperature gradients on the flat plate. The Mach number varied from 2.0 to 4.36 and the Reynolds number based on boundary-layer thickness varied from approximately 0.22×10^6 to 2.22×10^6. The incident shock-turning angles were 6°, 8°, and 10°. The data show that the impingement of a two-dimensional incident-reflecting shock on a turbulent boundary layer decreases the boundary-layer velocity profile. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-19801# United Kingdom Atomic Energy Authority, Wantage (England). Research Group.
AN INVESTIGATION USING RADIOACTIVE TRACERS INTO THE SILT MOVEMENT IN AN EBB CHANNEL, FIRTH OF FORTH, 1965
D. B. Smith, T. V. Parsons, and R. L. Cloet 1965 21 p
(AERE-R-5080) HMSO: 4s

Investigations of the silt movement from the Oxcars spoil ground using radioactive tracers have shown that this spoil ground is unsatisfactory due to extensive upstream transport of spoil from the area. An investigation of an alternative spoil ground in an ebb channel near Oxcars was undertaken using ground glass tracer labelled with Lanthanum-140. The results show that the spoil would be widely distributed downstream of the deposition area without approaching existing harbors on the estuary. Upstream movement of spoil was very limited during the three day period of the investigation. Author

N66-19854# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AURORAS AND IRON DEPOSITS
O. Morskov and V. Lyustiberg 15 Dec. 1965 5 p Transl. into ENGLISH from Kazakhstansk. Pravda (USSR), 12 Jan. 1965 p 4
(FTD-TT-65-1295/1+4; AD-625250) CFSTI: HC $1.00/MF $0.50

This paper briefly discusses Soviet cosmological and geophysical research being conducted on aurora and their appearance over iron ore deposits, cosmic radiation, and electromagnetic fields in the vicinity of Earth and in interplanetary space. R.N.A.

N66-19875# Tohoku Univ., Sendai (Japan). Faculty of Science.
THE SCIENCE REPORTS OF THE TOHOKU UNIVERSITY. FIFTH SERIES: GEOPHYSICS
Mar. 1965 36 p refs *Its* Vol. 16, No. 3 CFSTI: HC $3.00/MF $0.50

CONTENTS:

1. EFFECT OF THE ANISOTROPIC IONOSPHERE ON THE HYDROMAGNETIC OSCILLATIONS Y. Kato and Y. Sato p 123–145 refs (See N66-19876 10-13)

2. ON THE AFTERSHOCKS OF OGA EARTHQUAKE, MAY 7, 1964 p 146–163 refs

3. EFFECTS OF TRANSITION ZONE AND LOW VELOCITY LAYER ON FREQUENCY SPECTRA OF PLANE SH WAVES K. Emura p 164–172 refs (See N66-19877 10-13)

N66-19876 Tohoku Univ., Sendai (Japan). Geophysical Inst.
EFFECT OF THE ANISOTROPIC IONOSPHERE ON THE HYDROMAGNETIC OSCILLATIONS
Yoshio Kato and Yoshiaki Sato *In its* The Sci. Rept. of the Tohoku Univ., 5th Ser. Mar. 1965 p 123–145 refs (See N66-19875 10-13) CFSTI: HC $3.00/MF $0.50

The geomagnetic micropulsations with the period from about 120 sec to 600 sec which are observed in high latitude are considered as the standing oscillation of the geomagnetic field lines which pass through the stations in high latitude. The primary wave will be excited by the monochromatic source force acting radially in the exosphere on the equatorial plane, and it will propagate to the north and south hemisphere separately along the field line. The authors calculated the power spectrum and polarization of this standing oscillation between the north hemisphere and the south hemisphere, and the effect of the anisotropic ionosphere on these hydromagnetic oscillations. It is interesting that only odd mode oscillation is predominant if the source force acts symmetrically on the equatorial plane in the outer exosphere. The rotational sense of the primary wave is not influenced by the anisotropy of the ionosphere and the local dependence of the sense of rotation of the vector of pc5 is not explained by the effect of anisotropy of the ionosphere. The amplitude of the disturbance produced by the primary HM-wave which has counterclockwise sense are larger than that of disturbance, produced by the primary HM-waves which has clockwise sense. Author

N66-19877 Tokohu Univ., Sendai (Japan). Geophysical Inst.
EFFECTS OF TRANSITION ZONE AND LOW VELOCITY LAYER ON FREQUENCY SPECTRA OF PLANE SH WAVES
Kinya Emura *In its* the Sci. Rept. of the Tohoku Univ., 5th Ser. Mar. 1965 p 164–172 refs (See N66-19875 10-13) CFSTI: HC $3.00/MF $0.50

Transition zone, which is sometimes assumed to be at the Mohorovicic discontinuity, and low velocity layer within the upper mantle are simulated by two velocity functions, of which the derivatives are continuous and finite. Frequency spectra of reflected and transmitted plane SH waves from each transition zone are theoretically studied. The Moho transition zone of more than 0.2 km in its effective thickness has a stronger effect on the frequency content in near-vertical reflections than the absorption of energy in the crustal layer with $Q>250$. The low velocity layer amplifies reflected waves, although the effect may be too small to be recognized at the frequencies above 0.1 cps. Frequency dependence of transmitted waves for both types of the transition zones considered is almost negligible. Author

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N66-19921# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STUDY OF METEOR MATTER
T. N. Nazarova 13 Jan. 1966 9 p Transl. into ENGLISH from Geofiz. Byul., Akad. Nauk SSR, no. 14, 1965 p 89-91 (FTD-TT-65-1418/1+4; AD-626962) CFSTI: HC $1.00/MF $0.50

Electronic equipment for recording the number of meteoritic particle impacts is briefly described and some results are given. From 100 to 300 km above the earth, for particles with an approximate mass of 10^{-8} g, the average number of impacts per 1 m^2/sec is 3.0×10^{-1}; from 400 to 2000 km the number is 3.0×10^{-3}. The number of impacts decreases slowly from 2000 to 10,000 km, after which it decreases sharply. It is pointed out that Soviet and American data taken together justify the assumption of a dense dust envelope surrounding the earth from 100 to 300 km. Two theories are offered to explain the existence of this envelope including the suggestions: (1) that there exists a special class of interplanetary particles which have a relatively nonsubstantial structure and possibly consist of ice crystals; and (2) that the dust is a result of meteoritic collisions in the vicinity of the earth. D.T.

N66-19929# Tohoku Univ., Sendai (Japan). Faculty of Science.
SCIENCE REPORTS OF THE TOHOKU UNIVERSITY. Fifth Series: GEOPHYSICS, VOLUME 16, NUMBER 1
Feb. 1965 51 p refs
CFSTI: HC $3.00/MF $0.50

CONTENTS:

1. HEIGHT PROFILES OF DENSITY, COMPOSITION, AND IONIZATION IN THE MARTIAN ATMOSPHERE H. Kamiyama p 1–14 refs (See N66-19930 10-30)

2. ON A POSSIBLE MECHANISM FOR THE RULES OF POLARIZATION OF pc5 GEOMAGNETIC PULSATIONS Y. Kato and T. Tamao p 15–36 refs (See N66-19931 10-13)

3. EVALUATION OF CLOUD SEEDING EFFECT BY STATISTICAL ANALYSIS OF SNOWFALL AMOUNT IN THE TOHOKU DISTRICT, JAPAN S. Yoshida (Sendai District Meteorol. Obs.) p 37–47 refs (See N66-19932 10-13)

N66-19931 Tohoku Univ., Sendai (Japan). Geophysical Inst.
ON A POSSIBLE MECHANISM FOR THE RULES OF POLARIZATION OF pc5 GEOMAGNETIC PULSATIONS
Yoshio Kato and Tsutomu Tamao *In its* Sci. Repts. of the Tohoku Univ. Feb. 1965 p 15–36 refs Presented at ULF Symp., Boulder, Colo., Aug. 1964 (See N66-19929 10-13) CFSTI: HC $3.00/MF $0.50

With relation to the possible origin of the geomagnetic pulsations, the qualitative consideration on the interaction of the solar wind with the magnetosphere is given. As a possible mechanism for the polarization rules of the observed perturbation vector of pc5 pulsations, which show the counterclockwise rotation of polarization ellipse on the forenoon and clockwise on the afternoon sides in the northern hemisphere, the authors discussed the transverse hydromagnetic waves, caused by the fluctuations of the asymmetric radial stress of the solar wind, acting on the boundary surface of the magnetosphere on the daylight side. Using the cylindrical model it is shown that the

proposed mechanism can explain the above mentioned polarization rules, including some another characteristics of these pulsations. Author

N66-19932 Sendai District Meteorological Observatory (Japan).
EVAUATION OF CLOUD SEEDING EFFECT BY STATISTICAL ANALYSIS OF SNOWFALL AMOUNT IN THE TOHOKU DISTRICT, JAPAN
Sakumatsu Yoshida *In* Tohoku Univ. Sci. Repts. of the Tohoku Univ. Feb. 1965 p 37–47 refs (See N66-19929 10-13) CFSTI: HC $3.00/MF $0.50

In every winter since 1953, ground-based seeding with silver iodide smokes has been carried out in the Tohoku district, northern part of Honshu, Japan, for the purpose of increasing snowfall. The seeding effect which was evaluated by two ways of statistical analysis of snowfall amounts, was as follows: (1) From comparison of snowfall amounts for seeded and non-seeded days under typical monsoon it was found that a remarkable increase of snowfall, reaching around 20 percent on an average, occurred 50 to 100 km leeward of the seeding points on seeded days. (2) Stochastic test for the ratio of ten day snowfall amounts at the target points to those at the control ones on seeded periods showed that the increased snowfall amount in the target area was significant at the level of significance of 4 percent. Author

N66-19942# Weapons Research Establishment (Australia).
EARTH SHADOW COMPUTATIONS FOR TWILIGHT ROCKET EXPERIMENTS
K. H. Lloyd and C. H. Low Jun. 1964 44 p refs
(WRE-TN-HSA-99) CFSTI: HC $2.00/MF $0.50

The problems in estimating the position of the earth's shadow produced by the setting or rising sun are discussed. A method is described for calculating the time at which the earth's shadow is at a given altitude, to an accuracy within 0.1 min of time, and a table is given from which the time may be obtained to an accuracy of 1 min for any day of the year, provided that the earth's shadow height is less than 300 km. An investigation of allied problems is also made. In particular, results for the time rate of increase of the earth's shadow height and the depth of the penumbral zone are given. Author

N66-20040# Joint Publications Research Service, Washington, D. C.
RECENT STUDIES IN GEOPHYSICS
M. P. Volarovich et al 21 Feb. 1966 18 p refs Transl. into ENGLISH from Dokl. Akad. Nauk USSR, Ser. Mat. Fiz. (Moscow), v. 165, no. 4, 5, 6, 1965 p 1287–1293
(JPRS-34230; TT-66-30671) CFSTI: $1.00

The measurement of velocities of longitudinal elastic waves in rock samples at pressures to 40,000 kg/cm^2 was undertaken. Piezoceramic converters with a natural frequency of 3 Mc/sec were used for exciting and receiving the ultrasonic oscillations. The pressures exerted were close to hydrostatic pressures. In all rocks tested, the velocities of propagation were found to increase with increased pressure, the greatest increase being with the initial pressure. The mineral composition was found to have a predominant influence on the velocity in the region of 10,000 kg/cm^2 and more, and on structural–petrographic factors for the lower pressures. The concentration of cloud condensation nuclei was also determined. The apparatus used consists of an isothermal diffusion chamber, a photoelectric analyzer of individual drop sizes, and a five-channel electronic recording apparatus. The cloud nuclei concentration is found from the concentration only of those drops whose size exceeds the critical size for a particular supersaturation. Results were compared with data from other experiments, and graphs shown. N.E.N.

N66-20064# International Geophysical Year World Data Center A, Washington, D. C.
CATALOGUE OF DATA IN WORLD DATA CENTER A: AIRGLOW, IONOSPHERE, AURORA (INSTRUMENTAL), AURORA (VISUAL), COSMIC RAYS, GEOMAGNETISM, AND SOLAR ACTIVITY, 1 JANUARY 1960–30 JUNE 1964
Nov. 1964 94 p refs

Presented is a catalogue of airglow and ionosphere data received by the IGY World Data Center-A for the period 1 January 1958 to 31 August 1964. The IGY WDC-A was established as part of the contribution of the United States to the International Geophysical Year program. Although originally established for the IGY program, the Data Center continues as a permanent agency for the collection of all pertinent data, for assisting in effective international exchange of data, and for making the data easily available to the scientific community for research. Ionosphere data reported includes information on vertical incidence soundings, ionospheric electron density, absorption, ionospheric drift, atmospheric radio noise, whistlers, and backscatter. Data in the following categories are also presented: aurora (both instrumental and visual), cosmic rays, geomagnetism, and solar activity. M.R.W.

N66-20078*# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
MEASUREMENT OF UPPER ATMOSPHERE HELIUM PROFILE Final Report
A. E. Barrington 22 Nov. 1965 33 p refs
(Contract NAS5-9211)
(NASA-CR-70944; GCA-TR-65-28-N) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Work was performed to upgrade a tandem mass spectrometer to be used for measuring the helium and hydrogen profiles between 125 and 1500 km with a Javelin rocket. To facilitate a meaningful hydrogen measurement, an ultra-high vacuum bakeable stainless-steel analyzer was designed, fabricated and tested; however, tests were confined to an unbaked vacuum system. In order to measure the helium and hydrogen number densities, a minimum detectable signal capability of 10^{-12} A at the multiplier output is desirable. Although the original multiplier had adequate gain and a dark current well below this value, it was mechanically incompatible with Javelin specifications. Two commercial ruggedized multipliers were investigated, one in a sealed-off envelope, the other incorporated in the new stainless-steel mass spectrometer. This new mass spectrometer has adequate resolution and sensitivity for the proposed measurements. Recommendations regarding the attainment of this objective are also made. Author

N66-20121# Geotechnical Corp., Garland, Tex.
OPERATION OF THE WICHITA MOUNTAINS SEISMOLOGICAL OBSERVATORY Semiannual Report No. 2, 1 Dec. 1964–31 May 1965
8 Jun. 1965 77 p
(Contract AF 33(657)-13582)
(TR-65-52; AD-625462) CFSTI: HC $3.00/MF $0.75

This project includes the operation, evaluation, and improvement of the Wichita Mountains Seismological Observatory (WMSO) located on the Fort Sill Military Reservation in southern Oklahoma. The purpose of WMSO is threefold. First, the standard instrumentation of the observatory is maintained and continually evaluated and seismometric data are recorded, analyzed, and reported to the United States Coast and Geodetic

Survey (USC and GS) daily. Second, WMSO is used as a field laboratory where new instruments and techniques are tested and evaluated to determine their value for use at an observatory. Third, the data recorded at WMSO are studied, separately and in conjunction with data from other observatories, in an effort to improve and refine interpretive techniques and to learn more about earthquake mechanisms and the mechanisms of propagation of seismic waves through the earth. TAB

N66-20122# Geotechnical Corp., Garland, Tex.
OPERATION OF TWO OBSERVATORIES Quarterly Report No. 2, 1 Aug.–31 Oct. 1965
[1965] 61 p refs
(Contract AF 30(657)-12373; ARPA Order 624)
(TR-65-128; AD-625461) CFSTI: HC $3.00/MF $0.75

This report describes the operation of the Blue Mountains Seismological Observatory and Unita Basin Seismological Observatory during the period of 1 August through 31 October 1965. Modifications and additions to the observatory instrumentation are described and tests to improve the operation of the observatories are reported. Also discussed is the progress of special investigations designed to evaluate and improve the detection capacity of the observatories. Author (TAB)

N66-20123 Geotechnical Corp., Garland, Tex.
OPERATION OF TWO OBSERVATORIES Quarterly Report No. 1, 1 May–31 Jul. 1965
31 Jul. 1965 43 p
(Contract AF 33(657)-12373; ARPA Order 624)
(TR-65-99; AD-625460) CFSTI: HC $2.00/MF $0.50

This report describes the operation of the Blue Mountains Seismological Observatory and Unita Basin Seismological Observatory between the period of 1 May through 31 July 1965. Modifications and additions to the observatory instrumentation are described and tests to improve the operation of the observatories are reported. Also discussed in this report is the progress of special investigations designed to evaluate and improve the detection capacity of the observatories.
Author (TAB)

N66-20142*# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
LANGMUIR PROBES FOR MEASUREMENTS IN THE IONOSPHERE
L. G. Smith Oct. 1965 53 p refs Submitted for Publication
(Contract NASw-1141)
(NASA-CR-71017; GCA-TR-65-25-N) CFSTI: HC $3.00/MF $0.50 CSCL 04A

The design and use of a DC probe for rocket measurements of electron density and electron temperatures in the ionosphere is described. The probe is based on the Langmuir probe technique in a form which is particularly suitable for the investigation of features of the ionosphere involving steep gradients, such as sporadic E. The potential value of the probe in the D region is indicated. Author

N66-20167# Library of Congress, Washington, D. C. Aerospace Information Div.
METEORITICS Surveys of Soviet-Bloc Scientific and Technical Literature
2 Jun. 1964 15 p refs compilation of abstracts
(AID-U-64-51; AD-623252) CFSTI: HC $1.00/MF $0.50

Abstracts of Estonian studies on meteorites are given, including: the fall of comets and meteorites on the earth; meteorite craters, especially the Kaali and Ilumetsa craters; geophysical, mineragraphic, and chemical studies of craters; and composition o of Tamarugal and Yardymlinsk meteorites. Data on the meteorite collection of the Estonian Academy of Sciences are also summarized. N.E.N.

N66-20273# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
SPIN PRECESSION IN GRAVITATIONAL FIELD
V. I. Zakharov and I. Yu. Kobsarev 1965 12 p refs *Its* Rept.-329
(NP-15397)

The equality of precession frequencies of electron spins and classical gyroscopes in gravitational field is discussed. It is shown to follow from the linearized interactions as well as from the iterated Dirac equation in four-leg formulation.
Author (NSA)

N66-20306# Naval Research Lab., Washington, D. C. Physical Chemistry Branch.
FILTER PACK TECHNIQUE FOR CLASSIFYING RADIOACTIVE AEROSOLS BY PARTICLE SIZE. PART 3: THE SIZE DISTRIBUTION OF AIRBORNE FISSION PRODUCTS DURING 1963 AND 1964
L. B. Lockhart, Jr., R. L. Patterson, Jr., and A. W. Saunders, Jr. 29 Jul 1965 18 p refs
(Contract AT(49-7)-2435)
(NRL-6305) CFSTI: HC $1.00/MF $0.50

Some 60-odd collections of radioactive particulate matter dispersed in the atmosphere have been made during the past two years by use of a filter pack technique utilizing four superimposed filters. The distribution of radioactivity among the filters was analyzed mathematically by means of four simultaneous linear algebraic equations which relate the particle size of the retained material to the filter characteristics so as to permit the assignment of radioactivity in each collection to four major size groupings: 1.0μ, 0.6μ, 0.3μ, and 0.15μ particle diameter. The fission-product radioactivity collected at ground level is associated with particles having an "average" diameter between 0.3 and 1.1μ (assuming spherical particles of 1.8 g/cc density). The conclusion is reached that the extremely small radioactive particulates characteristic of nuclear bomb debris which have resided for an extended period in the stratosphere become attached to the larger nonradioactive aerosols typical of troposphere air by the time they arrive at ground level. A comparison of the relative amounts of various long-lived fission products (^{144}Ce, ^{147}Pm, ^{90}Sr, ^{137}Cs) and of the natural isotope RaD (^{210}Pb) in month-long collections by four-filter packs shows no significant evidence of fractionation effects among the long-lived fission products. This confirms the importance of the attachment process to the size of radioactive fission product conglomerates detected at ground level. Fresh debris from the Chinese nuclear test, however, exhibited a different isotopic distribution with size than did the older bomb debris. Proportionately more of the shorter-lived radioactive fission products collected during transit of debris from the Chinese test appeared in the largest particle size grouping. Author (NSA)

N66-20380# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
A MODELING STUDY OF THE MERIDIONAL TEMPERATURE PROFILE AND ENERGY TRANSFORMATIONS IN THE LOWER STRATOSPHERE
Li Peng 7 Apr. 1965 169 p refs *Its* Rept.-13
(Contract AT(30-1)-2241)
(MIT-2241-4) CFSTI: HC $5.00/MF $1.00

A simplified hemispherical dynamical model was employed to study the meridional temperature profile in the lower stratosphere and its relation to the energy transformations. In a numerical experiment an equator-to-pole temperature increase was produced in the upper layer of the model despite the imposed diabatic heating being poleward-decreasing in each layer. The mean value of the equator-to-pole temperature increase is in agreement with the one observed in the lower stratosphere. The averaged energy flow in the upper layer clearly displays the passive nature of the layer. The eddy kinetic energy appears to be a direct or indirect source of other forms of energy; it is converted into zonal kinetic energy and into eddy available potential energy which in turn is converted into zonal available potential energy. Both the zonal and eddy available potential energy suffer a net adiabatic loss. The eddy kinetic energy is reinforced by vertical transport from below. It was found that the major process directly responsible for the equator-to-pole temperature increase in the upper layer is the up-gradient transport of heat in the layer due to large-scale eddies. It was also found that up-gradient heat transports in the upper layer are simultaneously accompanied by energy conversions from eddy kinetic into eddy available potential energy in the upper layer and also accompanied by the opposite energy conversions in the lower layer. Therefore the equator-to-pole temperature increase in the upper layer is a characteristic of the passive nature of large-scale motions in the layer. Further numerical experiments using a simpler dynamical model were performed to examine how the equator-to-pole temperature increase in the upper layer depends upon the ratio of the imposed thermal Rossby number in the upper layer to the imposed thermal Rossby number in the lower layer. The results indicate that (for other parameters fixed) there exists a critical value of the ratio such that if the ratio is super-critical no equator-to-pole temperature increase can be maintained in the upper layer. If the ratio is subcritical, the magnitude of the equator-to-pole temperature increase in the upper layer does not seem to depend significantly upon the imposed thermal Rossby number in the layer. Author (NSA)

N66-20436# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

DETECTION OF ATMOSPHERIC TRITIUM BY SCINTILLATION. VARIATIONS IN ITS CONCENTRATION IN FRANCE [DETECTION DU TRITIUM ATMOSPHERIQUE PAR SCINTILLATION. EVOLUTION DE SA CONCENTRATION EN FRANCE]

Roland Bibron (Ph.D. Thesis–Paris Univ.) 1965 104 p refs In FRENCH

(CEA-R-2629)

The tritium released into the atmosphere as a result of the explosion of thermonuclear devices is a useful radioactive tracer for the study of certain geophysical problems. The low concentrations found, however, call for the use of extremely sensitive detectors. Two detection methods using liquid scintillators are described. In the first method, the sample is introduced into the scintillator in liquid form, after prior concentration of the tritium by electrolysis. In the second method, the tritium is incorporated into the scintillator solvent molecule by chemical synthesis. The variations in the tritium concentration in rain water and of the free hydrogen in the air in France are examined. A discussion is then given of the seasonal variations in the case of rain water and these are compared to the variations in the strontium-90 concentrations. Author (NSA)

N66-20575# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.

METHOD OF SELECTING ORIENTATED SAMPLES FROM IRREGULARLY BEDDED ROCKS FOR PALEOMAGNETIC STUDIES

V. V. Krugliakov Aug. 1965 3 p refs Transl. into ENGLISH from the book "Rock Magnetism and Paleomagnetism" Krasnoyarsk, Publishing House of the Siberian Div. of the Acad. of Sci. of the USSR, 1963 p 425–427

(T-432-R; AD-627127) CFSTI: HC $1.00/MF $0.50

The phenomena of irregular bedding, encountered in working with magnetic sedimentary formations, are discussed, and the necessity for determining the bedding plane in marking a sample is stressed. It is pointed out that although alluvial deposits characteristically show a regular variation in dip angle, the orientation in aeolian formations does not follow a regular system. For avoiding orientation error, it is recommended that samples be marked according to the cross bedding and then, by introducing a correction, converted from the coordinate system of the irregular bedding to the coordinate system of the tectonic dip-angle. E.A.O.

N66-20643# Little (Arthur D.), Inc., Cambridge, Mass.

INTERNAL WAVES BIBLIOGRAPHY

Sep. 1965 30 p refs

(Contract NObsr-93055)

(Rept.-4030965; AD-625237) CFSTI: HC $2.00/MF $0.50

This bibliography has been prepared as a part of a study of the military implications of internal waves. It includes all papers concerning internal waves in the ocean, given a wide distribution in the United States. Papers given limited distribution have been included when possible. Undoubtedly, many papers concerning references to internal waves or data which can be interpreted in terms of internal waves exist that are not included; however, this bibliography is believed to be complete with respect to papers dealing primarily with internal waves in the oceans. Entries are arranged in alphabetical order by author and date of publication. Author (TAB)

N66-20655# Weapons Research Establishment (Australia).

IONOSPHERIC DATA FOR JANUARY 1965 FROM SALISBURY, SOUTH AUSTRALIA

Oct. 1965 30 p

(CPD-1965/1(S)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for January 1965. Author

N66-20656# Weapons Research Establishment, (Australia).

IONOSPHERIC DATA FOR MAY 1965 FROM SALISBURY, SOUTH AUSTRALIA

Aug. 1965 30 p refs

(CPD-1965/5(S)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for May 1965. Author

N66-20660# Weapons Research Establishment (Australia).

W. R. E. DROPSONDE PROJECT Interim Report

C. J. Beach and A. D. Hind Nov. 1965 38 p refs

(WRE-PAD-108) CFSTI: HC $2.00/MF $0.50

This report discusses the dropsonde program to date (July 1965), with a brief description of the sonde and ground receiving equipment. Details of all the firings in the program are given, together with results and analysis of the wind, temperature and pressure profiles from 200,000 ft to 100,000 ft obtained from the 1965 firings. Author

N66-20666# Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSOI-CODE 131; 48°03'18" N, 07°35'24" E, JAN.–MAR. 1964 [IONOSPHAREN-DATEN, VERTICAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131; 48°03'18" N, 07°25'24" E, JAN.–MARZ. 1964]
[1964] 130 p In GERMAN and ENGLISH
(Rept.-208-F; Rept.-09-F; Rept.-210-F) CFSTI: HC $4.00/MF $1.00

Tabulated ionospheric data from vertical echo soundings taken at Freiburg, West Germany are presented, preceded by an explanation of the terminology used. R.N.A.

N66-20667# Naval Observatory, Washington, D. C.
SUNLIGHT, MOONLIGHT, AND TWILIGHT FOR ANTARCTICA, 1966–1968
Louise B. Weston 9 Apr. 1965 19 p *Its* Circ. No. 107
(AD-626268) CFSTI: HC $1.00/MF $0.50

Graphs are presented giving data concerning the rising and setting of the Sun and Moon and the duration of twilight for high southern latitudes. TAB

N66-20668# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
UPPER ATMOSPHERE PHENOMENA ASSOCIATED WITH THE 2+ SOLAR FLARE OF OCTOBER 22, 1963
William C. Kidd Oct. 1965 31 p refs *Its* Environ. Res. Papers No. 152
(AFCRL-65-762; AD-626167) CFSTI: HC $2.00/MF $0.50

The changes triggered by a solar flare in a number of atmospheric phenomena have been studied at one location. The X-ray induced events such as sudden ionospheric absorption occurring immediately after the flare were of relatively short duration, that is, one to two hours, and show the familiar course of events. However, the corpuscular-induced ionospheric events such as auroral absorption and scintillation which follow the flare by approximately a day and a half are of interest in their latitude variation. Some observations, such as 19Mc/sec radar backscatter and ionosoundings, show no time lag with reference to the commencement of the geomagnetic storm. The riometers show that the absorption phenomena commence first in the north and move in time to the south. The radiostar and scintillation observations show the same motion in time, that is, away from the auroral zone with the 200–400 km irregularities which produce scintillations showing a lower latitude boundary during the storm than before commencement. Author (TAB)

N66-20685# Denver Univ., Colo. Dept. of Physics.
VARIATION WITH ALTITUDE OF THE TRANSMITTANCE OF THE EARTH'S ATMOSPHERE WITH GRATING RESOLUTION Scientific Report No. 1
David G. Murcray, Frank H. Murcray, and Walter J. Williams Nov. 1965 25 p refs
(Contract AF 19(628)-5202; ARPA Order 363)
(AFCRL-65-854; AD-626632) CFSTI: HC $1.00/MF $0.50

The solar spectrum in the region from 3150/cm to 3950/cm was measured at various altitudes from 1.6 km to 31 km using a balloon borne grating spectrometer system. The spectral transmittance of the atmosphere above certain altitudes were deduced from these spectra. The observed spectral transmittance was compared with theoretical transmittance predicted by Plass considering only CO_2 absorption. The comparisons agree well at 15 km. At 30 km, the absorption by H_2O approximately equals the absorption by CO_2 and the theoretical transmittance (estimated from CO_2 only) differs from the observed. Author (TAB)

N66-20711# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.
PROGRESS ON A STUDY OF ATMOSPHERIC CIRCULATION TO 200 KILOMETERS IN TERMS OF DENSITY Scientific Report No. 3
V. S. Whitehead and W. J. Saucier Feb. 1964 56 p refs
(Contract AF 19(628)-489)
(AFCRL-64-256; ARL-1357-3; AD-601226) CFSTI: HC $1.50/MF $0.50

This report presents a summary of the results to date of a study of circulation to 200 km altitude in terms of density. Equations are developed which describe the behavior of density in hydrostatic atmospheres in general. The effects of vertical motion on the density departure from standard is shown for three hypothetical atmospheres. A method is developed for determination of the slopes of constant density surfaces from the wind field. The results of applying this method to the wind data taken from the Meteorological Rocket Networks are given. A simple two-dimensional model for the atmosphere between 90 and 220 km is constructed. This model is based on assumed equilibrium between absorption of solar electromagnetic radiation and downward conduction of thermal energy. Author (TAB)

N66-20778# California Univ., La Jolla. Dept. of Earth Sciences.
ABUNDANCES OF Na, Mn, Cr, Sc, AND Co IN ULTRAMAFIC ROCKS
Alan M. Stueber and Gordon G. Goles [1966] 45 p refs
(Grants NsG-319; NSF GP-3798)

A total of 113 ultramafic rocks, including dunites, peridotites, pyroxenites, imberites, serpentinites and peridotite inclusions, has been analyzed for sodium, manganese, chromium, scandium, and cobalt by a neutron activation technique. The overall average abundances determined are: 1040 ppm Na; 1040 ppm Mn; 2980 ppm Cr; 15.7 ppm Sc; and 1100 ppm Co. Na, Mn and Co values are markedly lower than the average abundances of these elements in ultramafic rocks as reported in the geochemical literature. When the fresh ultramafic rocks are compared with the serpentinites, by means of frequency histograms, the abundance ranges and the approximate variances about the mean are found to be the same, within experimental error, for each element studied. Thus, the process of serpentinization has no marked effect on the abundances of Na, Mn, Cr, Sc, and Co in ultramafic rocks. For those elements whose abundances are highly dependent on mineral composition, such as Na and Sc, it appears that the pre-serpentinization mineral composition rather than the process of serpentinization determines the elemental abundances in the serpentinite. Author

N66-20836# Naval Postgraduate School, Monterey, Calif.
ELECTRON BALLISTICS AND ELECTROMAGNETIC WAVES IN THE IONSSPHERE
Jesse G. Chaney 10 Nov. 1965 45 p
(TR-56; AD-626203) CFSTI: HC $2.00/MF $0.50

It is shown that ion collisions introduce a slight reduction in the plasma frequency, along with an exponential decay of transient electron oscillations. The critical frequencies for penetration of a homogeneous ionosphere, for both isotropic and anisotropic ionospheres, are determined. The characteristic waves, for electromagnetic propagation within a homogeneous anisotropic ionosphere, are developed by considering an infinite series of electron velocities, produced by Ampere's force law, reacting with the electron oscillation produced by an exciting electric field. The complex indices of refraction are determined, both from a dispersion equation and from a derivation of the Appleton equation, which uses an arbitrary selection of the coordinate axes, thus emphasizing the invariance of the Appleton equation. Vector and tensor algebra is used throughout the analytical developments. Author (TAB)

N66-20672*# Alaska Univ., College. Geophysical Inst.
HIGH LATITUDE GEOPHYSICAL DATA
V. P. Hessler, ed. Jun. 1965 92 p
(Contract NAS5-3595)
(NASA-CR-71161) CFSTI: HC $3.00/MF $0.75 CSCL 04A

The inter-relationship between solar, magnetospheric, and auroral phenomena was studied by reproductions of the cosmic radio noise level at 30 Mc/s that were monitored by zenith directed antenna in Alaska at 64.65°N, 256.56°E, geomagnetic. Variation of the noise level at the observation station was primarily attributed to the variation of precipitating auroral particles. Also included are N-S telluric current records and micropulsation data. The latter showed occasionally the narrow frequency range characteristics of pearl events at 0.2 to 0.5 cps during afternoon hours. G.G.

N66-20887*# Kansas Univ., Lawrence. Engineering Science Div.
SOME APPLICATIONS OF RADAR RETURN DATA TO THE STUDY OF TERRESTRIAL AND OCEANIC PHENOMENA
Willard J. Pierson, Jr., Bernard B. Scheps, and David S. Simonett [1965] 56 p refs Proc. of the 3d Goddard Mem. Symp. on Sci. Expt. for Manned Orbital Flight, Washington, D. C., 18–19 Mar. 1965 Am. Astronautical Soc. Sci. and Tech. Ser., v. 4
(Contracts NSR-17-004-003; Nonr-285(57))
(NASA-CR-71156; CRES-TR-61-3) CFSTI: HC $3.00/MF $0.50 CSCL 08

The application of imaging and altimeter-type radars mounted on orbiting spacecraft for high resolution radar mapping and scattering cross-section studies of terrestrial and oceanic properties was investigated. Emphasis was placed on: (1) Radar mapping; (2) characteristics of existing radar imagery; (3) new capabilities to be tested in imaging systems; (4) radar altimetry; (5) terrestrial applications in geology, glaciology, geomorphology, pedology, and agriculture; and (6) oceanic applications related to sea-state sensing. G.G.

N66-20903# Scientific Rocket Research Group on Space, Athens (Greece).
ON THE DETERMINATION OF GEODETIC CONSTANTS FROM ARTIFICIAL SATELLITES
C. L. Goudas 1962 28 p refs
CFSTI: HC $2.00/MF $0.50

The dynamic effect of the earth on an artificial satellite is studied by approximating the geopotential of a spheroid and two equal point-masses revolving in the equatorial plane of the earth with a period of one sidereal day. Both point masses lie on a straight line passing through the center of the earth. This approximation provides an automatic inclusion of the third harmonic term and accentuates the longitude dependent term, thus helping with its determination. G.G.

N66-20933*# Aerospace Corp., El Segundo, Calif.
GEOMAGNETIC GEOMETRY TABLES
James I. Vette and H Sylvia Porjes Washington, NASA, Mar. 1966 278 p refs Sponsored by NASA
(Contract AF 04(695)-469)
(NASA-CR-390) CFSTI: HC $2.95/MF $1.50 CSCL 04A

A set of tables has been prepared relating various coordinates used to describe trapped radiation: B, L, R, λ, x, and B_0/B. B and L are the usual McIlwain coordinates; R and λ are invariant polar coordinates computed from B and L using dipole relations; B_0 is the magnetic field strength at the equator of the line of force; and $X=(1-B_0/B)^{1/2}$ is the parameter introduced to better display particles near the equator. Author

N66-21034*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THEORETICAL METHOD FOR DERIVING AN EARTH-CENTERED DATUM FROM OPTICAL OBSERVATIONS OF THE EARTH'S HORIZON FROM AN EARTH SATELLITE
Ruben L. Jones Washington, NASA, Apr. 1966 62 p refs
(NASA-TN-D-3367) CFSTI: HC $0.90/MF $0.75 CSCL 08E

The necessary equations for a theoretical method for obtaining directly an earth-centered world geodetic system from angular measurements involving the earth's visible horizon as seen from an earth satellite are derived. As a check on the method, a computer program was written whereby data could be simulated and results obtained. The method is found to be mathematically feasible, and the results for a particular case are given to show the accuracy which can be expected under ideal conditions. Further, when large variances in the observations were assumed, the method was found to converge, although slowly. Finally, some of the conditions for the most effective application of the theory are determined. Although the method is found to be mathematically feasible and to converge for large variances in the measurements, the results are preliminary and a detailed statistical analysis is needed. As for additional applications, the theory can be useful in a variety of theoretical studies, such as a study of the accuracy penalties resulting from assuming the earth to be spherical rather than oblate in navigation schemes and horizon-uncertainty studies. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-19787# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
SUN TRACKER [POINTEUR SOLAIRE]
Jean Besson 1965 44 p refs In FRENCH; ENGLISH Summary *Its* Note Tech. No. 88
CFSTI: HC $2.00/MF $0.50

Main characteristics of a sun tracker, which is mounted on a space vehicle, are accuracy of its angular indications, adaptability to the severity of space environment, smallness of size, and low power consumption. An optical system associated with the cells permits detection of sun direction for any platform attitude. A servo loop gives an angular precision of a few minutes of arc. M.W.R.

N66-19791# Aeronautical Research Labs., Melbourne (Australia). Dept. of Supply.
AN APPLICATION OF SEMI-CONDUCTOR STRAIN GAUGES AND LOW NOISE LEVEL SLIP RINGS FOR THE MEASUREMENT OF TORSIONAL STRESSES IN A ROTATING SHAFT
E. G. Raines May 1965 40 p refs
(ARL/ME-265) CFSTI: HC $2.00/MF $0.50

A use of semi-conductor strain gauges for the measurement of low level fluctuating torsional stresses in a rotating shaft is described. The signals from the rotating shaft were

obtained by the use of slip rings and molybdenum wire collector brushes. Manufacturing details of the slip rings which incorporated wire race bearings are given, together with the method of fabrication of the molybdenum wire brushes. The calibrating equipment used to apply a static torque of 6,000 pound feet, and a fluctuating torque of 600 pound feet at approximately 200 cycles per second is described. Author

N66-19817# Naval Ordnance Lab., White Oak, Md.
VARIABLE RELUCTANCE TRANSDUCER FOR USE IN WIND TUNNEL PITCH DAMPING MEASUREMENTS
Frank J. Regan, Richard W. Ogan, and John E. Holmes Feb. 1966 36 p refs
(NOLTR-65-9; Aerodynamics Res. Rept.-242; AD-626926) CFSTI: HC $2.00/MF $0.50

This report describes the theory of operation and the electrical and mechanical design of a variable reluctance transducer for measuring the angular amplitude of a wind tunnel pitch damping model. Data acquired with this device are compared with those obtained using conventional photographic techniques. Author (TAB)

N66-19831 Radio Corp. of America, Princeton, N. J. Spacecraft Electronics.
TV CAMERA FOR THE COMMAND MODULE OF THE APOLLO SPACECRAFT
P. M. Zucchino and J. L. Lowrance *In its* Space Electron [1965] p 16–20 . Presented at the SMPTE Tech. Conf., New York, 28 Sep. 1964 (See N66-19827 10-31)

This light-weight TV camera for the APOLLO Command Module is demountable for hand-held use by the astronauts during flight. Since the APOLLO Lunar Excursion Module will also utilize a TV camera for the astronauts' use in actual exploration of the Moon's surface, the system design of the Command Module camera was strongly influenced by the anticipated requirements of video coverage while on the lunar surface, in order to take maximum advantage of common design approaches. Special design considerations for the sensor, optics, power supply, and automatic light-level compensation are given. In addition, a description of the operation of the video amplifier, yoke and deflection circuits, beam current regulator, and sync generator is presented. Since low weight was a prime requirement, hybrid and monolithic integrated circuits are used to the extent that the state-of-the-art allows. The camera is easily adaptable to other space applications with different scan and frame rates, thus making it attractive as a utilitarian unit. Author

N66-19834 Radio Corp. of America, Princeton, N. J. Astro-Electronics Applied Research Lab.
ASTRONOMICAL IMAGE SENSORS
Leslie E. Flory *In its* Space Electron. [1965] p 31–33 refs (See N66-19827 10-31)

High-altitude rocketry, satellites, and high-altitude balloons offer means for overcoming the limitations that the atmosphere places on ground-based astronomical sensors. This paper reviews the progress made to date on these new approaches to astronomical sensors and points out their special problems as well as their advantages. Discussed are imaging sensors, signal-generating sensors, pickup devices, and systems applications such as the Stratoscope I and II balloons, telescope orientation, and the possibility of using television to present visual data directly on the ground from an orbiting telescope. Author

N66-19835 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
SPECTRAL RESPONSE OF RANGER TV CAMERAS—MEASUREMENT AND USE
Louis Herczeg *In its* Space Electron. [1965] p 34-39 ref Prepared for JPL (See N66-19827 10-31)
(Contract NAS7-100)

All of the parameters of the Ranger TV cameras are fixed, and the electrical output of the cameras depends only on the luminance of the lunar scene. This output must be known in order to set the gain of the video amplifiers. However, a problem arises in that there is no usable source which approximates the Moon's spectral distribution and luminance; therefore, some other source must be used, and, based on its spectral distribution, its luminance will be set to provide the same output from the camera as would be provided if the lunar scene were observed. This paper describes the method for determining the luminance of this artificial source; also discussed are methods for measuring the spectral response of camera systems. Author

N66-19836 Radio Corp. of America, Princeton, N. J. Developmental Cameras.
A PROPOSED STEREOSCOPIC TV OBSERVATION SYSTEM FOR A LUNAR ORBITER
F. J. Bingley *In its* Space Electron. [1965] p 40-45 Presented at the SMPTE Tech. Conf., New York, 28 Sep. 1964 (See N66-19827 10-31)

This camera system has been proposed for use on the Surveyor orbiter spacecraft. To provide information concerning the topography of the lunar surface, the camera system provides stereoscopic pairs of images. Methods of achieving stereoscopy at the desired resolution of 10 meters of lunar surface are discussed. The relation between orbital parameters, and the extent of lunar surface surveyed is considered in relation to available sensor resolution. The optical system requirements are described in terms of aperture and focal length necessary to perform the mission under the conditions of illumination, lunar albedo, resolution, and signal-to-noise ratio. Author

N66-19852# Martin Co., Orlando, Fla.
MILLIMETER AND SUBMILLIMETER DEVICE RESEARCH First Quarterly Progress Report, Jul. 1–Oct. 1, 1965
J. J. Gallagher and R. E. Cupp Oct. 1965 23 p refs
(Contract DA-28-043-AMC-01236(E))
(OR-6791; AD-625958) CFSTI: HC $1.00/MF $0.50

Molecular beam investigations were continued with the Ramsey interferometers separated by 27 inches. This operation yields a linewidth as narrow as 350 cps. Broadening effects continue to be present. A description is given of a molecular beam apparatus which is being prepared for observations on lithium fluoride. Various experimental aspects of the molecular beam work and of millimeter techniques are discussed. Author (TAB)

N66-19897 Joint Publications Research Service, Washington, D. C.
AIRCRAFT FLIGHT INSTRUMENTS
Ch'i-huan Chou *In its* Transl. on Communist China's Sci. and Technol., No. 296 3 Mar. 1966 p 16–19 (See N66-19893 10-34) CFSTI: $2.00

Several types of flight instruments are described. The zero reading indicator has horizontal and vertical hands which indicate whether to climb or glide and whether to turn left or right. When the two hands are crossed in the center, the aircraft's position is correct. The guiding leveling meter gives the exact position of the aircraft and indicates whether to climb or glide and at what angle to bank left or right. However the

guiding leveling meter's position on the instrument panel makes it difficult to read during landing. A rotating indicator can be installed just below the windshield for easy reference. This indicator has black and white stripes similar to a barber pole which rotate to the left or right to show which direction the plane should be turned. Two such indicators can be combined to indicate both turn and climb or glide. These indicators can also be linked with automatic navigation equipment to automatically maintain a flying course or to turn to a new course. R.N.A.

N66-19937 Kyushu Univ., Fukuoka-Ken (Japan).
EQUIPMENT FOR MEASURING SIX MOTIONS OF A SHIP MODEL
Fukuzo Tasai, Masahiro Kaname, and Hiroyuki Arakawa *In its* Rept. of Res. Inst. for Appl. Mech. 1965 p 17–23 refs (See N66-19935 10-12) CFSTI: HC $3.00/MF $0.75

We have made equipment for measuring six motions of a ship model in waves. Making use of this equipment, excellent results of coupled motions in short-crested waves are obtained. A simple profile of this equipment is explained. Author

N66-19964# RAND Corp., Santa Monica, Calif.
UTILIZATION OF RIOMETERS FOR THE DETECTION OF NUCLEAR EXPLOSIONS IN SPACE
B. C. Potts Jan. 1966 31 p refs Submitted for Publication (Contract ARPA SD-79; ARPA Order 189-61)
(RM-4760-ARPA; AD-626946) CFSTI: HC $2.00/MF $0.50

The memorandum considers the detection of overhead nuclear explosions in space by riometer measurement of the effects of explosion induced ionization on the absorption of high frequency cosmic noise. The induced ionization is calculated as a function of height and time for a 1-kT X-ray impulse having temperatures of .5, 1.0, and 2.0 keV and having burst heights from 1,000 to 100,000 km. The absorption at each height due to the induced ionization is then calculated at a radio frequency of 30 Mc. In order to determine the change in the effective antenna temperature as a function of time at the riometer, the total absorption through the ionosphere is then determined. The response of a riometer with several time constants is found for this sharp change in received cosmic noise power. Detection ranges are calculated for each X-ray temperature and several possible riometer time constants based on the criterion that the nuclear burst must produce a 1 dB peak response in the diode current of the riometer. These detection ranges are tabulated and compared with those that were found neglecting riometer response time. Author (TAB)

N66-19981# Army Foreign Science and Technology Center, Washington, D. C.
RESULTS OF EXPERIMENTAL WORK ON DESIGN OF PHOTOGRAMMETRIC NETWORKS ON GENERAL-PURPOSE INSTRUMENTS
N. A. Sokolov, K. N. Gertsenova, and A. G. Vanin Dec. 1965 21 p ref Transl. into ENGLISH from Geodez. i Cartograf. (Moscow), no. 5, May 1964 p 28–41
(FSTC-381-T65-672; AD-626949) CFSTI: HC $1.00/MF $0.50

Route-networks of spatial phototriangulation were obtained by photogrammetric condensation of reference networks from a rarefied surface base. The aerial photo-survey was carried out by general purpose instruments with an 80 to 90% overlapping of the aerial photos. Coordinates of the vertical altitude photogrammetric points were reduced analytically for the different deformations of the aerial photos. This technology of photogrammatic condensing to a scale of 1:47,000 provided the required accuracy to determine elevations and vertical positions of various points in a stereotopographical survey at a scale of 1:25,000. G.G.

N66-19983# Army Foreign Science and Technology Center, Washington, D. C.
USE OF TRANSPARENT PLASTICS IN STEREOTOPOGRAPHIC PROCESSING
M. A. Blyumin (1965) 8 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), Jul. 1964 p 49–52
(FSTC-381-T65-620; AD-626790) CFSTI: HC $1.00/MF $0.50

The paper presents a short description of the technology involved in the use of plastic for stereotopographic processing and restoring of maps. Three types of processing may be done with plastics in the composition of topographic maps on conventional equipment: direct engraving of the original on the engraving layer of a plastic in steps according to the composition of the map from different elements (topography, contours, hydrography); engraving of the complete original (without separation into steps); production of the complete map serving as master for engraving of the original. Completed operations showed that with a khostafan plastic sheet it is possible to obtain original maps of a 3rd–4th degree of difficulty. When the more transparent astrolen plastic is used, it is possible to use this method in the preparation of maps of high degrees of difficulty. It is best to use transparent plastic in the composition of photographic layouts for the production of maps of flat regions. Experimental studies of the preparation of the photographic layout on transparent plastics by means of a rinsed relief were carried out. It is known that according to these techniques only striated copies can be obtained on the gelatinous layer. To obtain a half-tone original, such as a photographic layout, a 72 1/mm screen was used through which images were printed by the contact method from the halftone negative onto the gelatinous, color-sensitive layer applied to the plastic. TAB

N66-20007# Boeing Co., Seattle, Washington. Aerospace Group.
DISPLAY DEVICE, DRY FILM PROCESSING OF OVERLAYS FOR DATA DISPLAY First Quarterly Progress Report, 1 Jun.–31 Aug. 1965
Roy C. Wilcox (1965) 39 p refs
(Contract DA-28-043-AMC-00452(E))
(Rept.-1; AD-626192) CFSTI: HC $2.00/MF $0.50

The report reviews the general approaches to the problem of creating a display device which accepts an electrical signal input and records the information on a dry processed film suitable for multiple gate projection. Preliminary specifications for frame sizes and fixing the approach to the copy technique facilitated ordering the transfer lens. Four CRT phosphors were tested with reference to supplying the energy to expose Kalvar film. Resolution requirements for the various copy stages were assigned, and three fibre optic face plates were ordered. Measurements on Radio Frequency Interference from arc lights used in the film copy process were made and a shielded lamp house was designed. Kalvar chips furnished by USAECOM were checked for performance characteristics. Author (TAB)

N66-20012# Honeywell, Inc., Minneapolis, Minn. Aeronautical Div.
RESULTS OF TEST PROGRAM ON AIRCRAFT DEW POINT HYGROMETER Final Report, 8 May 1964–1 Oct. 1965
John E. Crowley and Steve F. Rohrbough 15 Nov. 1965 80 p
(Contract AF 19(628)-3285)
(AFCRL-65-873; AD-626159) CFSTI: HC $3.00/MF $0.75

An aircraft dew-point hygrometer was evaluated to determine the operating limits of dew point, altitude, Mach number, ambient air temperature, response time, and repeatability. The unit was evaluated under the environmental conditions of MIL-E-5272E and flight tests were simulated in a humidity atmospheric chamber. The test results indicated that the test system is best suited for low altitude sampling from aircraft flying at low Mach numbers. System improvements needed to extend this altitude and Mach number were determined. The improved system should be limited to minimum dew points of −60°F to avoid the increased response time occurring as dew point temperatures are decreased. Author (TAB)

N66-20023# Kaiser Aircraft and Electronics, Palo Alto, Calif. Electronics Plant.

EXPERIMENTAL EVALUATION OF HEAD-UP DISPLAY HIGH BRIGHTNESS REQUIREMENTS

Charles R. Kelly, James M. Ketchel, and Peter H. Strudwick Nov. 1965 32 p refs

(Contract AF 33(675)-8260)

(HFR-9765-1; AD-626657) CFSTI: HC $2.00/MF $0.50

The HUD, or Head-up part of Kaiser's Vertical/Head-up Display, is an avionics device that collimates and projects symbology onto the real world at infinity. It enables a pilot to look through the aircraft windscreen while viewing command and status information without requiring visual accommodation changes. This experiment was undertaken to determine what symbol brightness is required to use the Head-up Display under high background brightness conditions. The anticipated worst situation (other than looking directly into the sun) consists of flight over sunlit clouds or snow, in which case there could be continuing background brightnesses on the order of 10,000 foot lamberts against which the display must be seen. Results indicate that pilots will want display contrasts of at least 20 to 35 per cent, i.e., perhaps 1800 to 3500 ft. L. display brightness reflecting from the HUD combining glass, assuming 90 per cent transmission by windscreen and combining glass and an external background luminance of 10,000 ft. L. The minimum brightness contrast for a barely visible, near-threshold display is on the order of 10 per cent, or 900 to 1,000 ft. L. reflected from the combiner. This will provide an extremely dim display, but one that most pilots can be expected to see more than 90 percent of the time. Author (TAB)

N66-20048# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).

AN AREA GAMMA MONITOR WITH AUTOMATIC RANGE CHANGING

A. R. Jones Dec. 1965 21 p

(AECL-2533) CFSTI: HC $1.00/MF $0.50

An area gamma monitor is described which is intended for the measurement of exposure rates in the range 0.2 milli-Roentgens/hour to 10 Roentgens/hour. The output is displayed on two quasi-logarithmic ranges and automatic range changing is provided to switch the monitor to the less sensitive scale whenever a selected exposure rate is exceeded. The monitor has a rapid response. The detector unit, containing two geiger tubes, may be separated from the main unit by at least 300 feet of cable. A detailed circuit description and a setting-up procedure are contained in the appendices. Author

N66-20108# Texas Univ., Austin. Electrical Engineering Research Lab.

INSTRUMENTATION FOR GEOFIELD MEASUREMENTS

George Hopkins Jr. 31 Dec. 1965 46 p refs

(Contract Nonr-375(14))

(Rept.-138; AD-627021) CFSTI: HC $2.00/MF $0.50

The instrumentation and measurement techniques used by the Geomagnetic Division of the Electrical Engineering Research Laboratory of The University of Texas in making micropulsation measurements are described. Expressions for the transfer function are given to allow a complete analytical representation of the system. Field technique is discussed. Author (TAB)

N66-20111# Naval Medical Research Lab., New London, Conn. Acoustical Research and Development Div.

INSTRUMENTATION FOR ACOUSTIC AND VIBRATION MEASUREMENTS

Robert York Chapman 1 Jan. 1966 83 p refs

(TR-224-66; AD-627041) CFSTI: HC $3.00/MF $0.75

This technical report contains operational procedures for the General Radio Sound Level Meter Type 1551-B/C, Endevco Accelerometer and Control Box Type 1560-P13, Sound and Vibration Analyzer Type 1564-A, Graphic Level Recorder Type 1521-A, Vibration Calibrator Type 1557-A and the Strobotac Electronic Stroboscope Type 1531-A. These instruments manufactured by the General Radio Company are presently authorized for SS (N) and FBM Class Submarines. The intent of this report is to publish, in one assembly, practical information on the operations of a complete sound and vibration measuring system. Author (TAB)

N66-20134*# Battelle Memorial Inst., Columbus, Ohio.

EVALUATION CAPABILITIES FOR TRANSIENT PRESSURE TRANSDUCERS Summary Report

John M. Allen 15 Feb. 1966 23 p refs

(Contract NASr-100(06))

(NASA-CR-70925) CFSTI: HC $1.00/MF $0.50 CSCL 14B

The measurement of transient pressures in rocket combustion chambers imposes severe performance requirements on pressure transducers, especially during severe combustion instabilities. Technical and experimental capabilities have been established for the appropriate evaluation and diagnosis of dynamic pressure transducers intended for this application. The laboratory environmental conditions currently available at Battelle for use in transducer studies are described. Static pressure calibration, coolant flow calibration, sinusoidal pressure generator, and shock tube facilities are discussed. Improvements needed in evaluation capabilities are also mentioned. R.N.A.

N66-20149# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMPUTING THE ALLOWABLE SCATTERING OF LIGHT IN AERIAL CAMERAS

V. M. Kopylov 4 Jan. 1966 10 p refs Transl. into ENGLISH from Geodez. i Karograf. (Moscow), no. 12, 1964 p 39–42

(FTD-TT-65-1429/1+4; AD-627117) CFSTI: HC $1.00/MF $0.50

The criterion of resolving power is used to calculate the allowable scattering of light in aerial cameras. Expressions are given for the change in the resolving power of the photographing system depending on the contrast of the test object, and the magnitude of the change in the contrast of the image. An expression is derived using the image contrast change, and factors for altitude, and air and landscape conditions which permits calculation of the allowable magnitude of the absolute light scattering coefficient for an aerial camera. An example is given for obtaining the allowable value of the absolute coefficient under conditions of a 10% decrease in resolving power of an image, determined from a target of low contrast. E.A.O.

N66-20170# Geotechnical Corp., Garland, Tex.
GEOTECH ANALOG SPECTRUM ANALYZER
W. W. Whyte, III and R. S. Simons 16 Jul. 1965 94 p refs
(Contract AF 33(657)-12145)
(TR-65-67; AD-626403) CFSTI: HC $3.00/MF $0.75

The Geotech analog spectrum analyzer and the manner in which it operates are discussed in general terms. The fundamentals of Fourier analysis, as they relate to the operation of the system, are outlined. Sufficient detail is provided to give a working comprehension of the analyzer and the spectrograms it produces. The results of various tests on the electronic characteristics of the system are presented. These include frequency and phase response, noise level, and linearity. An assessment is made of the overall accuracy of the spectrograms. The spectra of simple repetitive waveshapes and transients are discussed and examples given.
Author (TAB)

N66-20176# Aerojet-General Corp., Sacramento, Calif.
GEMINI STABILITY IMPROVEMENT PROGRAM (GEMSIP). VOLUME 6: INSTRUMENTATION Final Report
W. J. Nort et al 31 Aug. 1965 363 p refs For Abstract see N66-19925 10-28
(Contract AF 04(695)-517)
(GEMSIP-FR-1, Vol. 6; SSD-TR-66-2, Vol. 6; AD-626765) CFSTI: HC $7.00/MF $1.75

N66-20177# Texas Instruments, Inc., Dallas.
LARGE APERTURE SEISMIC ARRAY Final Specifications Report, 1 Oct. 1964–30 Jun. 1965
Hubert M. Rackets Aug. 1965 160 p refs
(Contract AF 33(657)-13899)
(AD-626777) CFSTI: HC $5.00/MF $1.00

This report describes the installation of Angela and Hysham subarrays of the Large Aperture Seismic Array (LASA). Each subarray consists of 24 peripheral instruments located on six radials. At each location within the subarrays a borehole was drilled approximately 200 ft deep, cased and cemented. A Hall-sears HS-10 seismometer was then lowered into each borehole. Data from the seismometers are amplified at the wellhead of each borehole and transmitted to a central gathering point by buried cable. Lightning protectors were installed. Data from the two subarrays was used in carrying out two studies. First, the subarray systems were evaluated from engineering viewpoint in order to determine those elements and characteristics which would affect the desired performance of the array. Second, characteristics of the seismic information field (signal and noise) were determined with a single subarray and between the two subarrays. Summarizing the results from the engineering study, the system noise with the seismometer replaced by its equivalent resistance is about 30 to 35 db below the ambient seismic noise at 1.0 cps. This is an improvement of 8 to 12 db of separation over previous array systems at CPO, UBO and BMO. Author (TAB)

N66-20212 Sandia Corp., Albuquerque, N. Mex.
SUPPLEMENT REPORT ON COMARS (COORDINATE MEASURING AND RECORDING SYSTEM)
J. R. Rosborough and C. L. Stoner Jul. 1965 15 p Supersedes SC-TM-352-63(24)
(Contract AT(29-1)-789)
(SC-TM-65-332; SC-TM-352-63(24)) CFSTI: HC $1.00/MF $0.50

A system is described for digitally measuring and recording linear dimensions accurately to ±0.0001 inch. The system is rugged enough to be used in a normal factory environment. The results of an error-of-measurement study made on this system are also reported. Author

N66-20256# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
GUIDED FLYING SPOT SYSTEMS FOR SPARK CHAMBERS
Martin Deutsch [1965] 6 p Presented at the Purdue Conf. on Instrumentation for High Energy Phys., Lafayette, Ind., 12–14 May 1965
(Contract AT(30-1)-2098)
(MIT-2098-155; CONF-650510-6) CFSTI: HC $1.00/MF $0.50

The efficiency and operation of raster scan and programmed scan flying-spot systems for spark chamber track analysis are compared and evaluated. NSA

N66-20264# California Univ., Berkeley. Lawrence Radiation Lab.
A LOW-COST PERSONAL RADIATION MONITOR
Henry S. Dakin 29 May 1964 22 p refs
(Contract W-7405-ENG-48)
(UCRL-11199) CFSTI: HC $1.00/MF $0.50

An inexpensive and highly reliable pocket-sized (1 by 2-1/4 by 3-1/2 inches) warning device was developed for use by workers around radiation sources. Electric circuitry incorporates some important features made possible by recent technological advances, including use of low cost npn silicon transistors for temperature stability. No specially made or individually selected components are used. Mechanical design features include shock mounted printed circuit construction to minimize damage due to dropping and to simplify repairs, and provision for optional addition of a sensitivity changing switch and external speaker output, for remote monitoring purposes. Based on the original concept of R. H. Dilworth and C. J. Borkowski of Oak Ridge, this instrument gives an audible indication of approximate gamma radiation intensity between about 10^{-4} and 1 roentgen per hour by means of scaling or integrating of Geiger–Müller tube pulses, and gives a steady loud tone indication of higher intensities up to above 10^{6} roentgens per hour. Uncalibrated thermal neutron sensitivity is achieved by use of an optional thin silver foil surrounding the G–M tube. Response to radiation from pulsed radiation sources is limited by the G–M tube's dead time of approximately 20 μsec. Battery life is about 2000 hours. Approach of the end of battery life is indicated by a change in the output signal, although the instrument's calibration is retained throughout the battery's useful life. Author (NSA)

N66-20291# California Univ., Berkeley. Lawrence Radiation Lab.
SENSITIVE DIFFERENTIAL PRESSURE SYSTEM FOR MEASURING DEPTHS OF CRYOGENIC LIQUIDS
William L. Pope and Edwin F. Mc Laughlin 26 Aug. 1964 8 p refs
(Contract W-7405-ENG-48)
(UCRL-9672, Rev.) CFSTI: HC $1.00/MF $0.50

A system for measuring depths of cryogenic liquids is described. The indicating device is a commercial differential-pressure gage; the level-sensing probes are of various types, either permanent or removable. The heat leak to the cryogenic liquids may be made negligibly small. Author (NSA)

N66-20304# Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Aircraft Nuclear Engine Lab.
HIGH-TEMPERATURE THERMOMETRY AT CANEL
P. Bliss 8 Feb. 1965 21 p Presented at AEC Tech. Meeting on High Temp. Thermometry, Washington, D. C., 24–26 Feb. 1965
(Contract AT(30-1)-2789)
(CONF-650204-8; TIM-888) CFSTI: HC $1.00/MF $0.50

The febrication and performance of thermocouples from

temperature and that of the calorimeter is detected by a thermopile, and the output voltage of the thermel is observed on a meter after amplification. The amplified output also automatically controls the temperature of the adiabatic shield by programming a D.C. power supply. The temperature of either calorimeter is measured with a platinum resistance thermometer affixed around the interior of its adiabatic shield. The Chromel/Alumel, Nb, Zr, W, Re, and Mo for use at very high temperatures is reported. A thermocouple flow diagram is included. NSA

N66-20329# California Univ., Livermore. Lawrence Radiation Lab.
DESIGN OF MODULO-N COUNTERS FOR ANY CODE
R. Werner 7 Aug. 1964 15 p refs
(Contract W-7405-ENG-48)
(UCRL-12012) CFSTI: HC $1.00/MF $0.50

A step-by-step procedure is developed to design a flip-flop counter which will count to any number in any sequence. The logical properties of various flip-flops are used to minimize the circuitry required. Author (NSA)

N66-20331# California Univ., Berkeley. Lawrence Radiation Lab.
SEMICONDUCTOR DETECTORS FOR NUCLEAR SPECTROMETRY
Fred S. Goulding 30 Jul. 1965 178 p refs
(Contract W-7405-ENG-48)
(UCRL-16231) CFSTI: HC $5.00/MF $1.00

Four included lectures constitute a collection of essential information on semiconductor detectors and associated systems. The lectures concern: the descriptive theory of semiconductors, semiconductor detector technology and manufacture, factors determining the energy resolution in measurements with semiconductor detectors, and miscellaneous detector topics. Very few experimental results are given. NSA

N66-20343# Interstate Electronics Corp., Anaheim, Calif. National Marine Consultants.
ABSOLUTE PRESSURE SENSORS Interim Progress Report
Philip A. Folwell Oct. 1965 37 p
(Contract AT(26-1)-98)
(NVO-98-11) CFSTI: HC $2.00/MF $0.50

The method selected for monitoring and recording waves at deep water sites has necessitated the use of a buoy mounted pressure sensor at a depth of 600 to 1000 feet. The testing and calibration work to demonstrate the suitability of the transducer for the application, and to determine its characteristics so that accurate analyses of operational data can be made, are described. The design of the transducers is included. An investigation was performed to analyze possible hydrodynamic influences on the pressure measurement. The results are presented. NSA

N66-20347# Sandia Corp., Albuquerque, N. Mex.
SEMIAUTOMATIC BUBBLE CAMERA FOR CONTRAVES CINETHEODOLITE
May 1965 9 p
(Contract AT(29-1)-789)
(SC-TM-65-19) CFSTI: HC $1.00/MF $0.50

For safety reasons and convenience of operation, it was necessary to modify the bubble level camera on the Contraves cinetheodolite. This modification has changed the operation from manual to semiautomatic. Author (NSA)

N66-20350# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
AN APPARATUS FOR INVESTIGATIONS ON SCINTILLATOR PROPERTIES IN THE TEMPERATURE RANGE −100° C TO +50°C
G. M. de'Munari, G. Mambriani, and F. Giusiano Mar. 1965 17 p refs
(RT/FI(65)8)

A high sensitivity apparatus for measuring the properties of a scintillator is described. The scintillator temperature may be varied in the range −100 to +50° C. The scintillation light is detected by two Philips 56 AVP photomultipliers in fast coincidence; thus pulses, at the phototube noise level, can be examined. Fast pulses of light, roughly monochromatic, is sent to both phototubes. In this way it is possible to get for each phototube, as a function of the temperature, both the sensitivity and the spectral response. These measurements are rather reproducible (10%) for a given phototube, but there are remarkable differences between different phototubes. Author (NSA)

N66-20416# Commissariate a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
THE CALVET CALORIMETRIC DOSIMETER [LE DOSIMETRE CALORIMETRIQUE CALVET]
Jean-Rene Puig and Fulvio Romano Mar. 1965 31 p refs In FRENCH
(CEA-R-2768)

A description is given of a dosimeter based on the conduction calorimetry principle, and designed to operate in swimming-pool type nuclear reactors. The properties of the apparatus are as follows: (1) the measurement is independent of the specific heat of the calorimetric elements; (2) each calorimetric element is fitted with an electrical calibration; (3) the apparatus is made up of two independent calorimetric elements; (4) the nature of the calorimetric elements makes it possible to analyze the radiation received; (5) the measurable intensities of the absorbed radiation vary from 4 to 4,000 M/rads per hour; (6) the sensitive part of the apparatus is fitted inside a cylinder 5 cm high and 2 cm in diameter. One preproduction unit made up of graphite and beryllium cores has been tried out in the reactor Siloe with radiation intensities of about 1 to 2 watts per gram. It absorbed an accumulated dose of 1.2×10^{12} Rads without any weaknesses appearing. Author

N66-20503# Sandia Corp., Albuquerque, N. Mex.
HEIGHT-INTERVAL TIMER
C. G. Murphy Aug. 1965 10 p
(Contract AT(29-1)-789)
(SC-TM-65-356) CFSTI: HC $1.00/MF $0.50

A circuit which gives a measurement of the time a pulse is above a preset magnitude was developed. Called a height-interval timer, it offers a resolution of ±100 ηseconds, discriminates at levels less than 0.10 volts (with upper limits greater than 10 volts for the circuit tested), and has negligible hysteresis. The output of the circuit is a series of 10 megacycle pulses which, when counted, indicate the desired time. Author (NSA)

N66-20519# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
SEMI-AUTOMATIC DEVICE FOR SCANNING AND MEASURING SPARK CHAMBER PHOTOGRAPHS [POLUAVTOMATICHESKII PRIBOR DLYA PROSMOTRA I IZMERENIY A SNIMKOV S ISKROVYKH KAMER]
F. Legar, M. Maly, and O. Sgon 1965 28 p In RUSSIAN
(JINR-P-2340)

A semi-automatic device for scanning and measuring the spark chamber photographs was developed and constructed.

infrared detector cooling for the Nimbus prototype No. 2 are outlined, and results of laboratory tests on the bench and within an environmental space chamber to evaluate above modifications are reported. Preamplifier noise value decreased from 3.5 db to 1 db, but the entire subsystem did not show overall noise level improvement. A full time telemetry capability was achieved by putting all telemetry points on full power. Elec- The device has the following technical characteristics: it is meant for measuring the angles of track deflection on the photographs taken with standard 35-mm motion picture cameras, the magnification on the screen is tenfold, the device is provided with a black screen which allows to work by daylight, the film is automatically driven, the device has two regimes for driving the film: frame by frame and continuous, forward and backward, and the device records automatically the angular coordinates on the paper tape. Author (NSA)

N66-20528# Oak Ridge National Lab., Tenn.
CENTRIFUGAL FLOWMETER TESTS
W. R. Gambill 20 Apr. 1965 22 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1101) CFSTI: HC $1.00/MF $0.50

Calibration tests were made with two centrifugal flowmeters, fabricated by bending tubing into a 360-deg circle, by measuring the pressure differential between the inside and outside of the curved flow path between the ends of a tube diameter and relating it to the flow rate. It was found that the form of a proposed flow rate equation is correct, but that specific meters should be individually calibrated for accurate absolute results. Measurements of pressure loss between the inlet and outlet of a meter gave curved-section friction factors about a third larger than those previously reported for hydraulically smooth curved pipes. The total pressure drop across the meter tested was ~27% larger than that across an equal length of equally rough straight tubing. This type of meter appears to offer no clear-cut advantages beyond its simplicity. Author (NSA)

N66-20564# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
APPARATUS FOR MEASURING THERMOELECTRIC POWER AND HIGH-TEMPERATURE RESISTIVITY. RESULTS CONCERNING ARMCO IRON [APPAREIL DE MESURE DU POUVOIR THERMOELECTRIQUE ET DE LA RESISTIVITE A HAUTE TEMPERATURE. RESULTATS SUR LE FER ARMCO]
Michel Vandevyver, Dominique Byrde, and Halim-J. Albany Apr. 1965 11 p refs In FRENCH
(CEA-R-2783)

A description is given of an apparatus for the simultaneous measurement of thermoelectric power and electric resistivity of thermoelements between 50°C and 1000°C. Author (NSA)

N66-20576# Human Engineering Labs., Aberdeen Proving Ground, Md.
TARGET DETECTION USING BLACK-AND-WHITE TELEVISION. STUDY III: TARGET DETECTION AS A FUNCTION OF DISPLAY DEGRADATION
Lynn C. Oatman Sep. 1965 24 p refs
(TM-12-65; AD-627009) CFSTI: HC $1.00/MF $0.50

Two previous studies have examined the probability of detecting an M-48 tank on a black-and-white closed-circuit television (TV) system, with apparently conflicting results. When only horizontal resolution was reduced to get resolutions of 300, 400, 600, and 800 lines, detection performance was essentially the same for the three highest resolutions, though significantly poorer for the 300-line resolution. Yet when resolution was reduced in both horizontal and vertical dimensions, 800-line resolution gave better detection performance than 450-line resolution did. Extraneous variables that could not be controlled—such as uneven brightness and resolution on the TV monitors themselves—made it difficult to interpret these results. Thus it was not clear whether the first result was an unlikely chance event or whether resolution's effect depends on the number of dimensions reduced. The present study replicated the first one to test its verifiability. Displays at all four levels of resolution were presented to 20 subjects, who were asked to indicate in which one of nine areas the tank appeared on the TV screen. The results verified those of the first study; the subjects detected targets about equally well with the 800-, 600-, and 400-line resolutions, but their performance was significantly poorer with 300-line resolution. This finding suggests that, if resolutions are equal, reducing both horizontal and vertical dimensions will impair detection performance more than reducing just horizontal resolution (i.e., reducing bandwidth). Author (TAB)

N66-20710# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPENSATION DEVICE
O. P. Khvostov 7 May 1965 5 p Transl. into ENGLISH from Soviet Patent no. 160844 (Appl. no. 692589/26-3, 26 Feb. 1964) 2 p
(FTD-TT-64-1384/1+2; AD-615987) CFSTI: HC $1.00/MF $0.50

Object of the invention: A device for compensating constant, inductive and magnetic interferences of eddy currents, which contains auxiliary magnetometers, which is distinguished by the fact, that for the purpose of assuring the possibility of introducing corrections, into any part of the measuring system and also of compensating the interferences, in the circuits of the electrical load in it, there is used a computing device, the input of which is connected with auxiliary magnetometers, with shunts in circuits of electrical charge and with the output of the basic magnetometer, and the output signal is passed to a determined part of the system, for example, into the compensator coil, located on the sensitive element of the basic magnetometer. Author (TAB)

N66-20765 Prairie View Agricultural and Mechanical College, Tex. Dept. of Chemistry.
A SOLUTION CALORIMETER WITH AUTOMATIC ADIABATIC CONTROL DESIGNED FOR RARE EARTH RESEARCH
C. T. Stubblefield *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 3: Chem. Session C [1965] p 129-140 refs Sponsored in part by a Robert A. Welch Foundation Grant (See N66-20752 10-08) CFSTI: HC $4.00/MF $1.00

The thermochemistry of the rare earths requires a calorimeter having low heat capacity, and also extremely close adiabatic control since the heat liberated is often small and the reaction slow. These facts were considered in the design of this solution calorimeter. The associate control circuits for obtaining adiabatic conditions and the accompanying measuring circuits for temperature and heat equivalents may be used with either one of two unitized calorimeter assemblies. The smaller assembly accommodates a rare earth salt weighing about 0.1 gram reacting in about 28ml. of acid or water; and the larger one can handle 1 gram samples in nearly 300 ml. of water or acid. Each tantalum calorimeter is concentric with a copper adiabatic shield and an outer brass isothermal shield. The assembly to be used is operated in a 30 gallon water bath, controled at 23.00°C. The temperature of the adiabatic shield is controlled both manually and automatically by nichrome heaters wrapped on the outside. Any difference between this

heat capacities of the calorimeters are determined electrically. The heats of formation of $EuCl_2(s)$ and of the aqueous Eu^{++} ion have been determined in the larger unit. It is also being used to determine the heats of formation of other aqueous ions of the lanthanons, and of the non-stoichiometric oxides of praseodymium and terbium. Author

N66-20812# Harry Diamond Labs., Washington, D. C.
RESEARCH IN TRANSDUCERS Summary Report, Jul. 1957–Jun. 1964
H. D. Curchack, comp. 4 Oct. 1965 60 p refs
(HDL-TR-1306; AD-625946) CFSTI: HC $3.00/MF $0.75

Transducer research has been conducted at HDL, based on a Department of Army program initiated in July 1957. Most of the information attained when this program was terminated in June 1964 has been disseminated; however, certain phases of research have been completed since that time. This report therefore summarizes the documented material, as well as the subsequent efforts. Following a background description of this research program are report abstractions (Part I), taken from the documents considered most essential to the program. Also included are four reports (Part II), summarizing the undocumented results of subsequent work. Author (TAB)

N66-20831# General Precision, Inc., Binghamton, N. Y. Link Group.
SYNTHESIZED INSTRUMENT EVALUATION Technical Report, 1 Mar.–30 Apr. 1965
Joseph A. Berfanger Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., Sep. 1965 19 p
(Contract AF 33(615)-2895)
(AFFDL-TR-65-147; AD-627241) CFSTI: HC $1.00/MF $0.50

The Photographic Instrument Synthesizer System was developed within the Simulation Facility of the Flight Dynamics Laboratory to provide an economical approach to the evaluation of new concepts in aircraft instrument design. The Synthesizer System can present these concepts in the form of a 16 mm movie and thereby reduce the need for prototype equipment. Art work is used to represent the display elements of an instrument under consideration; several elements can be combined through multiple-exposure techniques. This report reviews the first two films produced with the Instrument Synthesizer; they pertain to two methods of displaying small changes in aircraft pitch angle. The first film concerns the feasibility of inscribing fine lines across the face of the standard Attitude Indicator to produce a strobe effect as the indicator moves through a small angle. The information gained from this film was subsequently incorporated in the design of an operational instrument. The second film was produced as a documentary film for presentation to the AIAA Conference in Dayton, Ohio; supporting scenes of the sequence of steps in the overall operation of the Synthesizer system were included to supplement the study of the small pitch angle display problems associated with an Attitude Indicator using an electron luminescent panel to replace the standard ball. Widely spaced lines on the face of the instrument were driven as a function of altitude to display the result of a change in pitch angle. This display is most effective in the portion of the instrument above its horizon reference line. Author (TAB)

N66-20845# Dayton Univ., Ohio. Research Inst.
A KINEMATIC DILATOMETER Interim Progress Report
Roger H. Keith Oct. 1965 11 p refs
(Contract AF 33(615)-1312)
(UDRI-TR-65-107; AD-626850) CFSTI: HC $1.00/MF $0.50

An inexpensive dilatometer with kinematically-suspended carriages is described. The instrument design features a large carriage baselength for stability and capability of measuring horizontal lengths of specimens as short as 4.5 inches. The design is adapted to high temperature workroom use by radiation shields which minimize the effects of thermal distortion. Dust shields and a design incorporating slanting carriage ways minimize grit buildup. The instrument may be easily constructed by a relatively unskilled machinist, as no close tolerances need be held to insure smooth, accurate operation. A procedure for aligning the dilatometer without the use of other instruments is also given. Author (TAB)

N66-20874*# Northrop Corp., Anaheim, Calif.
INTEGRATION OF AUTOMATIC CALIBRATION SYSTEM FOR VEHICLE INSTRUMENTATION Final Report
I. A. Shedd 16 Jul. 1965 52 p
(Contract NAS8-11705)
(NASA-CR-71154; NSS-3333) CFSTI: HC $3.00/MF $0.50 CSCL 09F

This report covers the investigations of future system checkout requirements while considering the application of the Automatic Calibration Technique (ACT) concept to active and passive checkout of remote systems. Computer operation using the ACT is described. For optimum efficiency, the RCA 110A computer is too slow for the considerations involved. Smaller and faster off-the-shelf computers, under control of the RCA 110A, could be used for the ACT, releasing the RCA 110A for other checkout routines. Onboard computers are discussed; it is felt that a small computer, used only for safety and control measurements pertaining to the spacecraft capsule in manned vehicles, would be advantageous. This computer would be redundant to one on the ground, but would be utilized strictly for astronaut use. No other instrumentation checkout computer would be required onboard. Also discussed is the utilization of an onboard programmer, which is set into operation by a single pulse from the onboard command receiver. Author

N66-20878# New Hampshire Univ., Durham. Dept. of Electrical Engineering.
THE DESIGN OF AN IMPROVED RECEIVER FOR ROCKET EXPERIMENTS
Frank David Szachta (M. S. Thesis) Aug. 1965 74 p refs
(Contract AF 33(608)-1256)
(AD-624654) CFSTI: HC $3.00/MF $0.75

In an ionospheric sounding experiment employing the Nike-Apache rocket electron density and collision frequency in the lower ionosphere are studied by means of rocket receiver signal frequency and strength as the rocket penetrates the ionosphere. The receiver used is an amplitude-modulated superheterodyne unit capable of receiving a signal strength of 5 microvolts/meter and amplifying it to a 5 volt level for the telemetry unit input. The problems encountered in this receiver are considered. They are: oscillator injection voltage amplitude into the mixer unit in very critical, causing the mixer to be unreliable; the intermediate frequency strip develops spurious oscillators; present receiver bandwidth of 10 kc. is too wide since broadcast land signals cause interference during test. TAB

N66-20892*# ITT Industrial Labs., Fort Wayne, Ind.
AN EXPERIMENTAL EFFORT TO IMPROVE THE NIMBUS RESOLUTION INFRARED RADIOMETER Final Report, 1 May 1964–15 Feb. 1965
W. H. Wallschlaeger, P. C. Murray, P. R. Sargent, and R. V. Annable [1965] 102 p
(Contract NAS5-3683)
(NASA-CR-71163) CFSTI: HC $4.00/MF $0.75 CSCL 20F

Electronics modifications as well as changes to improve

tronic amplifiers and voltage regulators were stabilized, and the calibrated staircase voltage was multiplexed with the output during the housing scan. The gear assembly was modified to attain the desired 30 rpm scan rate. Environmental tests on the fiberglass casting and the support rings with titanium wire, were successful. G.G.

N66-20905# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).

AN INSTRUMENT FOR MEASURING MAGNETIC FIELDS IN THE RANGE 0.01 TO 20 GAUSS WITH PEAKING-STRIPS

M. Placidi, G. Renzler, and S. Tazzari 16 Dec. 1965 15 p ref *Its* Nota Interna No. 296

(LNF-65/44) CFSTI: HC $1.00/MF $0.50

The design and performance of an instrument capable of measuring magnetic fields in the range of 0.01 to 20 gauss through pick-up of the voltage signal from a peaking-strip that is excited by a sinusoidal magnetic field of fixed frequency, is described. The amplitude of the peaks is a function of the amplitude and frequency of the excited field itself. An external, constant magnetic field, oriented along the peaker axis displaces the peaks and makes it possible to measure the axis position and asymptotes of a quadrupole magnet. A block diagram and circuit diagram of the magnetometer are shown. G.G.

N66-20926*# Hazleton Labs., Falls Church, Va.

THE DESIGN AND FABRICATION OF AN INSTRUMENT FOR THE DETECTION OF ADENOSINETRIPHOSPHATE (ATP)

Washington, NASA, Mar. 1966 236 p refs

(Contract NAS5-3799)

(NASA-CR-411) CFSTI: HC $2.50/MF $1.25 CSCL 14B

A method for the detection of life in the upper atmosphere and outer space was based on the selection of adenosinetriphosphate (ATP) as a monitor for the presence of life. The detection and quantitative assay of ATP exploits the bioluminescent reaction occurring in fireflies. The components of this reaction are an enzyme, luciferase, and two substrates, luciferin and ATP. With luciferase and luciferin held constant and in excess, the emission of light is theoretically proportional to the ATP added. The first phase of work has consisted of experiments designed to establish the optimal conditions for the preparation of luciferase and luciferin, and also to establish the optimal reaction conditions for maximum assay sensitivity. The second phase of this work has been the design and fabrication of a highly sensitive and versatile instrument for the measurement of the light emitted during the bioluminescent reaction. Author

N66-20944 Cambridge Systems, Inc., Newton, Mass.

DESIGN AND TESTING OF AN AEROSPACE DEW POINT HYGROMETER Final Report

2 Nov. 1964 28 p

(Contract NAS9-2917)

(NASA-CR-65262) CFSTI: HC $2.00/MF $0.50 CSCL 14B

This document describes the design and testing of an aerospace dew point hygrometer system, developed for use in spaceflight instrumentation systems. The hygrometer described is of the thermoelectrically cooled and optically detected dew condensing type. The hygrometer system consists of a miniature dew point sensing assembly, and a separate control amplifier, power supply, and signal conditioning package. The components are designed to meet rigorous space flight qualifications. Tests conducted to demonstrate that the hygrometer system meets such qualifications are described. Author

N66-20985# British Hydromechanics Research Association, Cranfield (England).

A BIBLIOGRAPHY ON HOT WIRE ANEMOMETRY

T. E. Brock and C. J. Moon Oct. 1965 43 p refs

(BIB-18) CFSTI: HC $2.00/MF $0.50

A chronological presentation is given to a bibliography on hot wire anemometry. Abstracts are included for many of the 175 references listed, and both subject and author indexes are appended. M.W.H.

N66-20995*# Texas Instruments, Inc., Dallas. Science Services Div.

STUDY OF QUANTITATIVE METHODS FOR LEM LANDING-SITE SELECTION Final Report

15 Mar. 1966 242 p refs

(Contract NAS9-3418)

(NASA-CR-65272) CFSTI: HC $6.00/MF $1.50 CSCL 14E

Mathematical, statistical, and optical-Fourier methods were developed for prediction of LEM landing safety against excessive slope and protuberance hazards. Systems utilizing data in elevation matrix, contour map, and photographic formats were considered. Detailed treatments based on elevation matrix data offer more promise than those involving contour maps because of physical handling problems and mechanization difficulties associated with the latter. Optical-Fourier techniques appear feasible for rapid comparison of gross regional features, but further development is required to attain operational status. In order to make certification measurements with 90 percent confidence in required accuracy, it was determined that improvements in the contemplated Orbiter camera system resolution and viewing geometry are required. Alternately, increased reliance must be placed on slope and protuberance measurements derived from Ranger and Surveyor photographs in conjunction with statistical estimates. Author

N66-20996*# Electro-Optical Systems, Inc., Pasadena, Calif.

SOLAR REFLECTING BEACON

D. E. Stewart and B. E. Kalensher 3 Dec. 1965 154 p refs

(Contract NAS9-4790)

(NASA-CR-65255; EOS-6976-Phase I) CFSTI: HC $5.00/MF $1.00 CSCL 17H

The following areas are discussed in the development of a lunar solar reflecting beacon: static and dynamic design concepts including tracking beacons, photometric analysis of beacon detection, reliability as affected by the lunar environment, materials analysis, beacon location requirements, and preliminary weight and packaging determinations. On the basis of this study, a tracking flat specular earth reflector with an area of 33 sq ft and a view field of 6.25×10^{-5} steradians is recommended. For a cislunar beacon to be viewed at a maximum slant range of 400 nautical miles, an oscillating arch specular beacon having a total surface area of 19 sq ft and effective reflective area of 4.44×10^{-2} sq ft is recommended. This beacon will meet design constraints and will transmit a flashing signal for 0.1 second once every 8.25 seconds. The detailed technical analyses of these recommended concepts puls other beacon types that were studied are discussed with actual data, analyses, tables, curves, diagrams, and sketches. C.T.C.

N66-21014*# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.

DEVELOPMENT OF A FLIGHT-QUALIFIED WHOLE-BODY DOSIMETER SYSTEM Final Report

R. Wiley and C. L. Fletcher 9 Sep. 1965 115 p refs

(Contract NAS9-3407)

(NASA-CR-65304; FZK-258) CFSTI: HC $4.00/MF $0.75 CSCL 06B

The development and construction of a whole-body dosimeter system for monitoring the radiation exposure to crew members during space missions is described. The system is a flight-qualified, self-contained unit consisting of a 6.8-cc ion chamber, electrometer, and electronics to drive a three-hand readout register. The system is capable of reading 0.1000 rad in 0.01-rad increments at a maximum rate of 108 rad/hr. The system weighs 0.8 lb, has a volume of 18.3 $in.^3$, and is contour shaped for compactness and easy handling. Construction details of the system, reliability estimates, qualifying tests, and operating instructions are given. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-19825# Naval Civil Engineering Lab., Port Hueneme, Calif.
BLAST RESISTANCE OF CHECK AND GATE VALVES Final Report
K. R. Bockman, J. C. King, and R. S. Chapler Nov. 1965 32 p refs
(N-756; AD-626831) CFSTI: HC $2.00/MF $0.50

The objective of this task was to determine the blast resistance of standard check and gate valves which may be used in protective shelter equipment and utility systems. To accomplish this objective, commercially available 3 inch 200 psi WOG (water, oil, or gas) bronze check and gate valves were subjected to transient air pressures to about 390 psi (the maximum capability of the Laboratory at the time of the tests) and to transient hydraulic pressures to about 2000 psi. Subsequent visual examination, operational tests, and hydrostatic leak tests revealed no damage to the valves, and test data indicated relatively low magnitudes of strain, which leads to the conclusion that standard check and gate valves can withstand transient loads far in excess of their rated capacity. In order to determine whether or not the valves may be dynamically loaded when subjected to a nuclear blast wave, the natural frequencies of the valves were obtained and compared to the rise time of nuclear explosions. This showed that if a blast wave reaches the valve without attenuation, dynamic loading could occur. If, however, the wave must propagate through a piping system to reach the valve, the wave front may be relatively unchanged, or it may steepen and possibly increase the dynamic loading, or it may be attenuated so that little or no dynamic loading would occur. In the case of shocks generated by the test equipment, it was shown that dynamic loading was not applied. Because the most severe loading conditions could not be produced by the test equipment, the exact configuration in which valves are to be used must be considered before recommendations can be made as to their blast resistance. TAB

N66-19842 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
PREDICTING SYSTEM CHECKOUT ERRORS
Warren D. Moon *In its* Space Electron. [1965] p 64-67 refs
(See N66-19827 10-31)

During checkout of space or weapon systems, two types of errors can occur: (1) not detecting an existing defect, and (2) calling a nondefective system defective. This paper develops equations which relate the two error types to test equipment accuracy and specification limits of system parameters. The problem is considered on both the individual measurement level and the total system test level. The results can be used to specify test equipment accuracy design criteria, or to determine the probabilities of the two types of errors when test equipment design is already fixed. Author

N66-19920# Illinois Univ., Urbana. Dept. of Civil Engineering.
FERROUS ARC WELDING. EFFECTS OF HYDROGEN AND RELATED VARIABLES ON THE PHYSICAL PROPERTIES OF WELDS ON STRUCTURAL STEELS
Sep. 1952 146 p refs
(Contract DA-33-017-ENG-96)
(AD-626994) CFSTI: HC $4.00/MF $1.00

Bend test specimens, prepared from bead-on-plate welds, were tested as simple beams on a 4-1/2 in. span with the weld beads in tension. The investigation included a study of variables affecting hydrogen embrittlement, of the effect of these variables in different regions of the weld, of possible methods of relieving the detrimental effects, and of a possible relationship between hydrogen embrittlement and restraint during welding. TAB

N66-19934# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
SHIP BUILDING AND NAVIGATION TECHNOLOGY—SURVEY OF LITERATURE [SCHEEPSBOUW EN SCHEEPVAART-TECHNIEK LITERATUUROVERZICHT]
15 Jan. 1966 37 p refs In DUTCH, ENGLISH, GERMAN, and FRENCH *Its* Vol. 11, No. S-178
CFSTI: HC $2.00/MF $0.50

Abstracts and bibliographic notes are included in the categories of ship types, resistance and propulsion, stability, strength computations and vibrations, design, equipment, docks, propulsion installations, ventilation and heating, sound insulation, navigation, rescue techniques, materials, [illegible] Transl. by J.O.

N66-19958*# Tyco Labs., Inc., Waltham, Mass.
LEAD TELLURIDE NON-MAGNETIC BONDING RESEARCH STUDY Second Quarterly Report, 1 Jun.-31 Aug. 1965
H. E. Bates and M. Weinstein [1965] 58 p refs
(Contract NAS5-9149)
(NASA-CR-70710) CFSTI: HC $3.00/MF $0.50 CSCL 13H

The purpose of this study is to define the most appropriate system and process for the reproducible fabrication of low resistance, high strength bonds of nonmagnetic electrodes to PbTe and PbTe-SnTe thermoelectric alloys. SnTe braze bonding of Ta and W electrodes to $Pb_{.5}Sn_{.5}Te$ thermoelements was studied, in addition to investigating diffusion bonding of W electrodes to $Pb_{.5}Sn_{.5}Te$. Some diffusion bonded elements were examined by the electron beam microprobe technique. The designing of a sixteen-specimen, gradient life testing device was completed. Author

N66-19963# Naval Missile Center, Point Mugu, Calif.
ELIMINATION OF SUBSTANDARD PARTS BY ENVIRONMENTAL TESTING
L. E. Matthews and R. C. Binder 20 Jan. 1966 15 p refs
(NMC-MP-66-1; AD-626842) CFSTI: HC $1.00/MF $0.50

Electromechanical hardware such as missiles, in general, exhibit three life phases; early failure, useful life, and wear-out. The primary cause of early failures are substandard strength parts. These substandard parts, frequently referred to as bugs, are parts whose strengths are much less than the average

strength of a normal or standard part. Substandard parts usually result from manufacturing defects or human errors in construction. The useful life period of a device is the period after all defective parts have been replaced and prior to the beginning of standard part wearout. The highest reliability is observed during the useful life period. Laboratory enviornmental tests are useful as a debugging procedure and as a means of investigating the reliability of a device with all parts of standard design strength. A series of debugging and failure rate tests were performed at the U. S. Naval Missile Center and the failure data were presented by a unique method, providing graphical representattions of reliability versus time. The data provided definite indications of early failure and useful life phases.
Author (TAB)

N66-19966# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Flugzeugbau.
THE POSSIBILITIES OF ADHESIVE BONDING OF METALS USING CERAMIC MATERIALS [DIE MOGLICHKEITEN DES KLEBENS VON METALLEN MIT KERAMISCHEN STOFFEN]
W. Althof 15 Oct. 1965 50 p refs In GERMAN; ENGLISH summary
(DLR-MITT-65-13) CFSTI: HC $2.00/MF $0.50

A survey on manufacturing techniques for metal joints with ceramic adhesives is presented. These adhesives are glassy heat resistant substances that contain amounts of metal or metal oxides. Various ceramic-metal adhesive combinations are evaluated, and the application of a ceramic adhesive-braze alloy combination technique is described. Insertion of a wire mesh into the glassy substance increased its stability considerably. Transl. by G.G.

N66-19979# General Electric Co., Hudson Falls, N. Y. Capacitor Dept.
PRODUCTION ENGINEERING MEASURE: POLYCARBONATE PLASTIC FILM Quarterly Report, 18 Aug.-18 Nov. 1965
Lawrence S. Lazar 18 Nov. 1965 26 p
(Contract DA-36-039-AMC-06165(E))
(QR-2; AD-626375) CFSTI: HC $2.00/MF $0.50

The extrusion equipment was completely set up and debugged for film operation, returning to the baseline conditions established previously. The manual feed system was evaluated and set up in a manner that eliminates moisture streaks. The biaxial orientation equipment was installed and mechanically debugged. The extrusion conditions for producing non-textured poly-carbonate film were optimized, and a series of 24-hour runs was made producing 2000 pounds of 0.4 mil and 1000 pounds of 0.5 mil film. Author (TAB)

N66-20013# Army Weapons Command, Rock Island, Ill. Research and Engineering Div.
HIGH TEMPERATURE OXIDATION INHIBITION OF ALUMINUM COMPLEX SOAP GREASE
Max T. Fisher Nov. 1965 23 p refs
(RIA-65-3264; AD-626582) CFSTI: HC $1.00/MF $0.50

The aluminum complex soap greases made previously (see AD-610 560) had good high and low temperature shear properties and good oxidation stability at 210° F but at 250° F were deficient in the latter property. Efforts to correct this deficiency consisted of incorporating antioxidants which had proved effective at the higher temperature in other grease types. The antioxidants were generally less effective at 250° F in these aluminum base greases than they were in other greases at the same temperature. Two of the inhibitors, 2,4'-diisopropyl amino diphenyl ether and a proprietary mixture of complex organic amines, did impart superior resistance to oxidation at 250° F. The former, in a one percent concentration, limited the pressure drop to 25 psi in 400 hours, and a 27 psi drop in 400 hours was recorded using the latter material in a 0.3 percent concentration. This work shows that it will be difficult to find antioxidants for limiting the pressure drop of aluminum complex soap grease to 20 psi in 400 hours at 250° F. Author (TAB)

N66-20021# Naval Ordnance Test Station, China Lake, Calif.
PROPELLER MANUFACTURE BY A NUMERICALLY CONTROLLED MILLING PROCESS
David R. Hamilton Jul. 1965 45 p
(NAVWEPS-8595, NOTS-TP-3607; AD-619016) CFSTI: HC $2.00/MF $0.50

The report describes the process by which a torpedo propeller was produced on a numerically controlled milling machine. The process involved several steps. First, a geometric conversion routine translated the design data from conventional blueprint form to a set of rectangular coordinates. These converted data were expanded into a more complete array by means of interpolation routines. Then, through the use of the APT (Automatic Programmed Tools) computer system, programs were processed that converted the expanded data into the commands that actually machined the propeller. It is expected that propellers machined in this fashion will eventually be more accurate and less costly than conventionally produced propellers. Author (TAB)

N66-20042# General Electric Co., Philadelphia, Pa.
THE NECESSARY TESTS FOR RELIABILITY
Charles A. Locurto 1 Oct. 1965 21 p refs
(Doc.-65SD307)

It is shown that a minimum reliability test program is necessary to assure that certain characteristics of the equipment are available to the customer. The report presents the considerations which enable the extent of a necessary reliability test program to be determined quickly. The discussion is directed to the small sample sizes and character of aerospace and missile systems, research and development component assemblies. An illustrative example is given for a necessary test program involving a set of real components in a hypothetical mission profile. The assurance resulting from this testing is tangible, since it is related to expectations of fundamental failure modes and analysis of hardware. Author

N66-20064# Plastics Research Inst. TNO, Delft (Netherlands).
REPORT ON THE RESEARCH CONCERNING THE DEVELOPMENT OF A PLASTIC JERRY CAN FOR THE STORING AND TRANSPORTING OF GASOLINE [VERSLAG VAN DE WERKZAAMHEDEN BETREFFENDE DE ONTWIKKELING VAN EEN KUNSTSTOFJERRICAN VOOR OPSLAG EN TRANSPORT VAN MOTORBENZINE]
O. F. Bartoo and J. C. Molijn 27 Oct. 1965 26 p In DUTCH
Its Rept.-149/65; 152/65
(KI-36/65; TDCK-43808) CFSTI: HC $2.00/MF $0.50

Extensive testing was conducted to define the permeability and impact strength of polycarbonate, cellulose acetobutylate, polyamide 11, polyamide 6, polyacetal, and high and low density polyethanes. To determine permeability, tubes of these plastics were constructed, filled with gasoline, sealed, and stored at about 20° C without further regulation of ventilation or conditioning for about 40 days. The findings show that the two polyamides are suitable; however, the polycarbonate and the low density polyethane materials proved unsuitable. A

modified Charpy technique was used to test impact strength. Results indicate that low density polyethane is the toughest but becomes brittle at −40° C. High density polyethane, polyamide 11, and polycarbonate are quite tough; polyamide 11 has a moderate impact strength, as does polycarbonate at 20° C. Polyamide 6 and the cellulose acetobutylate are somewhat brittle, and polyacetal was the most brittle. Fast bending test results revealed that low density polyethane is the most supple; polyamide 11, cellulose acetobutylate and high density polyethane moderately stiff; and polyamide 6 and polyacetal the least supple. Transl. by J.O.

N66-20055# Metaalinstituut TNO, Delft (Netherlands).
HARDNESS TESTS ON FLOTATION GEAR SHAFTS OF SIKORSKY HELICOPTERS
W. Hagg 28 Dec. 1965 9 p
(M-65-1154) CFSTI: HC $1.00/MF $0.50

Presented are results of a hardness survey performed on all floatation gear shafts of Sikorsky helicopters employed by the Dutch Navy. The survey was initiated in connection with the crash of two helicopters after the failure of flange components. The hardness tests were performed by using a diamond pyramid indenter under a load of 30 kgf (Vickers method). Series of tests were made across the flanged area and the corresponding Rockwell C hardness numbers are given. M.R.W.

N66-20062# France. Ministere de l'Air, Paris.
SOUNDPROOFING AND FILLING IN OF MOTORS [INSONORISATION ET REMPLISSAGE DES MOTEURS]
J. Rauch 1965 175 p refs In FRENCH
(Rept.-418) CFSTI: HC $5.00/MF $1.00

The acoustic principles are presented for attenuating automobile engine noise. The various aspects of soundproofing exhaust noise are discussed, along with the means for low pitch sound absorption; and a terminal reflection silencer system for total noise suppression is described. An admittance type silencer is also considered, and the requisite dynamic and acoustic conditions for its use are determined. Different materials are proposed for use as sound absorbers; and the case of acoustic supercharging and optimization is studied. Transl. by D. T.

N66-20116# Martin Co., Orlando, Fla. Materials Research Lab.
INTERPRETATION OF ELECTRON DIFFRACTION PATTERNS FROM AMORPHOUS BORON Technical Report No. 14
Henry M. Otte and Harry A. Lipsitt (ARL) Dec. 1965 24 p refs Submitted for Publication
(Contract Nonr-3706(00))
(OR-8000; AD-627018) CFSTI: HC $1.00/MF $0.50

Samples of boron prepared by a vapour thermal decomposition process were examined in the electron microscope. Selected area diffraction patterns showed diffuse rings which could be indexed as FCC; in several instances a hexagonal array of spots was obtained. The latter appeared unchanged on tilting the specimen in the electron beam, but more accurate measurements revealed that the spots were displaced relative to each other. Samples that had been gently heated in the electron microscope until all the diffuse rings had disappeared gave rise only to spot patterns which showed, when the specimen was suitably oriented with respect to the beam, pronounced streaks that were continuous from spot to spot. All these observations can be interpreted, at least semiquantitatively, in terms of a layer structure with extensive faults in the stacking sequency of the layers. The material as deposited has a very high density of stacking faults which are removed on heating, thereby converting the FCC cell of B12 groups into the rhombohedral structure of boron. Author(TAB)

N66-20118# Hercules Powder Co., Wilmington, Del.
INFLUENCE OF ENVIRONMENT ON ROVING AND LAMINATE PROPERTIES
J. T. Paul, Jr. and J. B. Thomson [1964] 26 p Presented at 5th Polaris Case Conf., Lockheed Missiles and Space Co., Palo Alto, Calif., 14 Jan. 1964
(Contract AF 04(647)-243)
(AD-625030) CFSTI: HC $1.00/MF $0.50

The paper discusses work done on the effect of environmental conditions, primarily on Owens-Corning's HTS-S glass roving, before and during filament winding. During storage, irreversible changes have been noticed in the HTS-S roving. Stiffness and ribbonization increase with time, rather rapidly at slightly elevated ambient temperatures. These physical property changes have been shown to cause variations in filament windings made from the aged glass. Chemical changes, responsible for the physical ones, have been identified and means of controlling both have been found. TAB

N66-20127*# New Hampshire Ball Bearings, Inc., Peterborough.
A DETAILED FAILURE ANALYSIS OF THE BALL BEARINGS FROM A MODEL 1631 TAPE RECORDER Final Report, 1 Dec. 1964–1 Nov. 1965
[1965] 41 p
(Contract NAS5-9525)
(NASA-CR-71026) CFSTI: HC $2.00/MF $0.50 CSCL 13I

In order to extend the life of a Nimbus tape recorder a study was conducted on the cause of recorder bearing failures. Various studies were made to evaluate the nature of the bearing failures and establish the required corrective action. Positive indications of lubricant oxidation were found and recommendations are made to reduce the oxidation difficulty. Work remains to be done to test the recommendations as well as follow through testing of points incompletely covered in the work. Author

N66-20136*# IIT Research Inst., Chicago, Ill. Technology Center.
ENVIRONMENTAL STUDY OF MINIATURE SLIP RINGS Quarterly Report No. 10, 1 Oct. 1965–1 Jan. 1966
O. M. Kuritza [1966] 21 p
(Contract NAS8-5251)
(NASA-CR-71021; E6000-29) CFSTI: HC $1.00/MF $0.50 CSCL 13K

Progress is reported on an environmental study of miniature slip rings to evaluate slip ring materials and design techniques suitable for high vacuum operation. Run-in tests of brush-ring assemblies in high vacuum showed that unacceptable noise levels were developed in a short time. New spectrographic analyses of off-gassing products from three different organic components used in experimental capsules indicated that the selected materials had good off-gassing properties. Apparatus was designed and is being fabricated to study friction, wear, electrical noise, and lubrication of different materials in high vacuum. Several promising candidate lubricants were selected. Run-in tests of two types of hard gold overlays in nitrogen atmosphere produced a type of debris which was not encountered in previous tests. Qualitative analysis of this debris is being conducted. Studies of electroplating effects were conducted in the presence of ultrasonic energy. No definite improvement in plating quality was obtained. R.N.A.

N66-20141*# Boeing Co., Seattle, Wash. Aerospace Group.
IDENTIFYING OPTIMUM PARAMETERS OF HOT EXTRUSIONS Progress Report No. 7, 12 Oct. 1965–14 Jan. 1966
[1966] 35 p refs
(Contract NAS7-276)
(NASA-CR-71016) CFSTI: HC $2.00/MF $0.50 CSCL 13H

The purpose of this program is to develop a technique for hot extruding MgO and to determine the effect of such hot extrusion on MgO and other oxide bodies. Successful extrusion of billets of varying diameter in a common can showed that the smallest (1") diameter hot pressed billets were free of cracks after extrusion. Thus, crack free extrusion of MgO is feasible. These crack free extrusions were found to fracture transversely when cut longitudinally, indicating residual stresses. Annealing for 1 hour at 1200°C relieved this stress and resulted in successful cutting of extrusions without producing cracks. Mechanical testing of these and other (unannealed) samples shows that extruded MgO is stronger than hot pressed MgO with approximate strength-grain size relationships being $S_e = 1.83 \times 10^5 G^{-.437}$ psi and $S_{H.P.} = 1.17 \times 10^5 G^{-.417}$ psi, respectively, where S_e and $S_{H.P.}$ = flexural strength in psi of extruded and hot pressed MgO respectively, and G = grain size in microns. However, chemical polishing in boiling phosphoric acid which normally increases the strength of MgO, reduced strengths of extruded MgO. This is believed to be due to residual stresses in unannealed extruded MgO. Author

N66-20143*# Mechanical Technology, Inc., Latham, N. Y.
STATIC STIFFNESS AND DYNAMIC ANGULAR STIFFNESS OF THE COMBINED HYDROSTATIC JOURNAL—THRUST BEARING
J. W. Lund Oct. 1963 70 p refs
(Contract NAS8-5154)
(NASA-CR-71018; MTI-63TR45) CFSTI: HC $3.00/MF $0.75 CSCL 13I

This report presents an analysis of the externally pressurized combined journal thrust bearing where the flow from the journal bearing feeds a double acting, annular thrust bearing. The analysis assumes a large number of feeder holes such that the two journal bearing feeding planes are treated as line sources. Furthermore, small displacements are assumed. The solution obtains results for flow, radial and axial stiffness and dynamic angular stiffness and damping, all for the concentric journal position. Two computer programs have been written and instructions for their use are included in the appendices. Two numerical examples are performed and the results are presented graphically. Author

N66-20160# Picatinny Arsenal, Dover, N. J.
STATIC LOAD DISTRIBUTION AND DYNAMIC OVERLOADING IN CYLINDRICAL GEARS OF THE SPUR AND HELICAL TYPES
Adam Morecki Jan. 1966 74 p refs Transl. into ENGLISH from Archiwum Budowy Maszyn (Warsaw), v. 8, no. 2, 1961 p 139-192)
(PA-TT-1; AD-627092) CFSTI: HC $3.00/MF $0.75

A method is presented for the study of the static load distribution between mating teeth, and for the study of the dynamic loading in cylindrical gear pairs with straight or helical teeth having an involute profile. Described are: the design of a test-stand based on the principle of revolving power, and the method of measurements by means of tensometric sensing devices. The results of measurements are shown for gears with different numbers of teeth and different moduli, also for gear pairs in various positions, all as related to the precision of gear cutting, their peripheral speed and the condition of loading. Analytical relationships are derived, which provide a basis for calculating the normal stress and the magnitude of the dynamic overload in such gears during engagement.
Author (TAB)

N66-20192# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
GAS EVOLUTION FROM SOLID PLUTONIUM-BEARING RESIDUES DURING STORAGE
D. J. Hodkin, R. S. Pitman, and P. G. Mardon Sep. 1965 20 p
(AERE-M-1644) HMSO: 3s 6d

Hermetically sealed cans containing solid plutonium bearing residues have on occasions pressurized during storage. This has been found to be due to radiolysis of moisture chemisorbed during the experimental life of the samples and in particular during long periods of storage in non-airtight containers sealed in bags. Pressurizing of the cans can be prevented by vacuum drying of the samples immediately before canning.
Author

N66-20229# California Univ., Livermore. Lawrence Radiation Lab.
HYDROSTATIC COMPACTING
Frank H. Miars 23 Apr. 1964 13 p refs
(Contract W-7405-ENG-48)
(UCRL-7841) CFSTI: HC $1.00/MF $0.50

The process of hydrostatic compacting of materials is described briefly. The equipment involved in the process is discussed. A 50,000-psi and a 150,000-psi compacting system are described in some detail.
NSA

N66-20254# Mechanical Technology, Inc., Latham, N. Y.
AN EXPERIMENTAL STUDY OF FILM RUPTURE IN JOURNAL BEARINGS WITH LOW KINEMATIC VISCOSITY LUBRICANTS May 1964–Feb. 1965
F. K. Orcutt and C. H. T. Pan Mar. 1965 63 p refs
(Contract AT(30-1)-3383)
(MTI-65TR13; NYO-3363-4) CFSTI: HC $3.00/MF $0.75

Studies of film rupture and cavitation in bearing film were extended to lubrication with fluids of low kinematic viscosity whose surface forces (surface tension and wettability) are different from those of hydrocarbon oils and closer to those of liquid metals. The study consisted of visual observations of the film rupture region, using high speed still and motion picture records. Local film boiling in the film rupture region was induced by de-aeration and reduction of ambient pressures. The visual studies and a parallel theoretical analysis indicated that the surface forces greatly affect the details of the film rupture region. Unstable film rupture regions as well as entrainment of bubbles and their carry-over to the high pressure regions of the lubricant film are much more prevalent when the lubricant has high surface tension and poor wettability. Since these conditions are at least a prerequisite to cavitation damage, it is particularly desirable in such cases to design bearings so as to avoid generation of large negative pressure gradients which can reduce the hydrodynamic pressures to the vapor pressure of the lubricant.
Author (NSA)

N66-20259# Mechanical Technology, Inc., Latham, N. Y.
AN INVESTIGATION OF ROTOR-BEARING DYNAMICS WITH FLEXIBLE ROTORS AND TURBULENT-FLOW JOURNAL BEARINGS. PART 1: ANALYSIS, DESIGN AND FABRICATION OF THE TEST APPARATUS Jun. 1964–Feb. 1965

F. K. Orcutt and E. B. Arwas Mar. 1965 76 p refs
(Contract AT(30-1)-3363)
(MTI-65TR12; NYO-3363-3) CFSTI: HC $3.00/MF $0.75

A description is given of the preliminary part of an investigation aimed at demonstrating feasibility and generating technology and design procedures on high speed rotors operating in the flexible rotor range while supported in pivoted pad journal bearings lubricated with a low viscosity liquid and operating in the turbulent flow regime. It is intended to operate three rotor arrangements over a speed range that, in each case, spans the first three system critical speeds and extends to above twice the first system critical speed. The rotor arrangements are: (a) central mass between two journal bearings, (b) central mass between the two journal bearings plus an overhung mass on one end, and (c) central mass between the journal bearings plus overhung masses on both ends. The analysis, design, and fabrication of the test apparatus is described. The calculated critical speed maps as well as the calculated vibration amplitudes and phase angles of the response of the rotor bearings systems to unbalanced loads are presented. NSA

N66-20297# Sandia Corp., Albuquerque, N. Mex. Manufacturing Process Development Div.
MOLDING PRECISION MICROBALLOON-FILLED EPOXY PARTS IN PLASTISOL MOLDS
Sep. 1965 9 p
(Contract AT(29-1)-789)
(SC-TM-65-462) CFSTI: HC $1.00/MF $0.50

A low-cost method for producing high-quality electronic packages of solid honeycomb is described. The molded parts are composed of a glass microballoon-filled epoxy resin, cast in a flexible plastisol mold. The procedures for making and filling the mold are fully described. Author (NSA)

N66-20317# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
HYDROSTATIC BEARING EXPERIMENTS
R. W. Skulski 11 Oct. 1965 4 p Presented at the IMOG and Metrology Subgroup Meeting, Las Vegas, Nev.
(Contract AT(29-1)-1106)
(RFP-667; CONF-651011-3) CFSTI: HC $1.00/MF $0.50

Experiments were conducted on designing hydrostatic journal bearings for ultra-precision applications. Bending and unroundness were found to affect load deflection and runout, respectively. The design of hydrostatic bearings for this type of application is discussed. NSA

N66-20321# Nuclear Metals, Inc., Concord, Mass.
FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY Monthly Progress Report, Dec. 1964
15 Feb. 1965 27 p
(Contract AT(30-1)-2784)
(NMI-2135; NYO-2784-6) CFSTI: HC $2.00/MF $0.50

Progress in establishing extrusion and drawing techniques for W–25 Re tubing is reported. Successful re-extrusions were obtained for 80-mil OD tubing from extruded stock that had received a recrystallization anneal. The drawn tubing is prone to crack, presumably because the roughly striated surfaces provide sites for stress concentration. Tests were made using material with surfaces conditioned to reduce the sharpness of the extrusion striations in an effort to determine whether such conditioning will inhibit cracking. The surface conditioning techniques and various drawing methods used are reported. Progress on the fundamentals of single-crystal deformation in zone-refined Be is also reported. NSA

N66-20323# Franklin Inst., Philadelphia, Pa. Research Labs.
THE APPLICATION OF GAS-LUBRICATED BEARINGS TO HIGH SPEED, TURBO-MACHINERY Final Report
J. G. Hinkle and D. D. Fuller 30 Jun. 1965 39 p refs
(Contract AT(30-1)-2512)
(F-A2392-3; NYO-2512-15) CFSTI: HC $2.00/MF $0.50

Information was obtained on the operation of a tilting-pad self-acting bearing in a test rig at super- and subatmospheric ambient pressures from 5 to 80 psia at speeds up to 21,000 rpm. The pivot pressure and film thickness were measured and compared with theoretical predictions. No direct correlation was obtained for the minimum film thickness, owing to the rotor bearings being designed for operation at standard atmospheric ambient conditions. During operation at conditions other than the optimum design conditions, the machine was insensitive to changes in ambient pressure. NSA

N66-20326# Battelle Memorial Inst., Columbus, Ohio.
EXPLOSIVE WELDING OF FLAT PLATES OF ZIRCALOY TO INCONEL "600"
R. J. Carlson, C. C. Simons, and E. G. Smith, Jr. 26 Jan. 1965 24 p
(Contract W-7405-ENG-92)
(BMI-X-328) CFSTI: HC $1.00/MF $0.50

Preliminary experiments are described which were aimed at developing explosive welding parameters suitable for metallurgically bonding together 4-in.-square plates to form a composite from which 3.4-in.-OD by 3.3-in.-ID by 1 to 1-1/2-in.-long tubular transition joints could be machined. Both nominally smooth mating surfaces and machined contour surfaces were investigated in the study. Although some welding was achieved in these experiments, it was not sufficiently extensive nor sufficiently reproducible to satisfy the requirements of the application. NSA

N66-20335# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
NONDESTRUCTIVE TESTING OF SMALL-DIAMETER REFRACTORY-ALLOY TUBING
K. V. Cook and R. W. Mc Clung 21 Apr. 1965 43 p refs Presented at Joint NASA-AEC Liquid Metals Corrosion Meeting, Gatlinburg, Tenn.
(Contract W-7405-ENG-26)
(ORNL-P-1543; CONF-650411-6)

A discussion is given of nondestructive methods used at ORNL to detect flaws and to measure dimensions of refractory metal tubes. The methods include ultrasonics, eddy currents, penetrants, radiography, and air gaging. The principles, equipment used, and applications of each method are discussed. NSA

N66-20362# Nuclear Metals, Inc., Concord, Mass.
FABRICATION OF SEAMLESS TUNGSTEN-25 w/o RHENIUM TUBING: FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY Summary Technical Report, 1 Jul. 1964–30 Jun. 1965
S. Isserow, G. I. Friedman, R. G. Jenkins, and A. L. Geary 15 Jul. 1965 123 p refs
(Contract AT(30-1)-2784)
(NMI-1267) CFSTI: HC $4.00/MF $0.75

The development program was directed toward the establishment of extrusion and drawing techniques for tungsten—25 wt % rhenium tubing in two sizes: 0.080-inch OD×0.008-inch wall, and 0.250-inch OD×0.020-inch wall. For each size, the primary extrusion is performed routinely. For the larger size, reliable techniques were developed and demonstrated for subjecting the extruded tubing to a series of moving-mandrel draws that iron the tubing to a reduction of about 30%. The

successful application of moving-mandrel drawing and subsequent reeling for mandrel removal depends on the proper combination of mandrel material and working temperatures. In addition, the tubing must be properly conditioned by appropriate surface preparation and thermal treatment. For the smaller size, the proposed sequence is based on re-extrusion of the product of the primary extrusion. Although some apparently satisfactory tubing was obtained by re-extrusion, conditions for consistently obtaining sound tubing were not established. The billet for re-extrusion incorporates a removable core of calcium carbide within the inner molybdenum filler. This carbide core is removed chemically from the extruded tube by acid drilling. The re-extruded tubing (OD about 0.1-inch) can be drawn with or without the inner extrusion fillers. The continuing metallurgical evaluations include some routine checks at various stages of fabrication as well as tests intended to guide the selection of anneals introduced in fabrication sequences. Author (NSA)

N66-20364# National Lead Co. of Ohio, Cincinnati.
SINK-REDUCTION OF HEAVY-WALLED STEEL TUBES
Herbert Davis and Herbert W. Hesselbrock 7 Dec. 1964 16 p refs Presented at Assoc. of Iron and Steel Engr. Rolling Mill Conf., Birmingham, Ala.
(Contract AT(30-1)-1156)
(NLCO-923; CONF-650431-1) CFSTI: HC $1.00/MF $0.50

The feasibility of using an industrial, three-roll, stretch-reducing mill for producing steel tubes in sizes equivalent to those of uranium fuel core blanks was successfully demonstrated. Heavy-walled steel tubes were reduced by sinking with light tension between stands and by stretching with heavy tension between stands. After rolling, the tubes could be machined to final dimensions with less stock removal than is required in the present core machining operation. Author

N66-20396# Sandia Corp., Albuquerque, N. Mex.
A SEMICONTINUOUS HOT PRESS TUNNEL KILN
G. H. Haertling Jun. 1965 11 p refs
(Contract AT(29-1)-789)
(SC-TM-65-276) CFSTI: HC $1.00/MF $0.50

A kiln was designed for the fabrication of high quality ceramics by hot pressing. The kiln includes a heated tunnel, a means for moving the parts in molds through the tunnel, and rams for pressing and then ejecting the parts. The kiln was operated to produce ferroelectric ceramics, and the results are described. NSA

N66-20430# Mechanical Technology, Inc., Latham, N. Y.
DESIGN AND DEVELOPMENT OF A GAS-BEARING BRAYTON CYCLE TURBOCOMPRESSOR
1 Mar. 1965 96 p
(Contract AT(30-1)-3237)
(NYO-3237-1; MTI-64TR7) CFSTI: HC $3.00/MF $0.50

A technology program has been underway since June, 1962 to demonstrate feasibility of, and to identify problem areas associated with, the application of gas-lubricated bearings to closed-system gas-turbine machinery. A Brayton cycle gas generator (turbocompressor) utilizing self-acting gas bearings has been designed, built, and is now under test. Self-sustained closed-loop operation of the turbocompressor, using its own cycle gas as the bearing lubricant, was achieved on November 21, 1964. Design point conditions of the turbocompressor are: turbine inlet temperature=1300°F, compressor inlet temperature=100°F, compressor inlet pressure=15.5 psia, turbocompressor speed=24,000 rpm, cycle gas flow=~6,700 lb/hr nitrogen, and simulated power output=~30 kw. The aerodynamic, mechanical, and instrumentation aspects of the turbocompressor design and development program are described. A brief summary of the initial test-performance is also presented. Author (NSA)

N66-20454# Roentgen Technische Dienst N. V., Rotterdam (Netherlands).
NON-DESTRUCTIVE WELDING TESTS Quarterly Report No. 14, 1 Oct.–31 Dec. 1964
29 Apr. 1965 24 p Transl. into ENGLISH from Dutch
(EURATOM-045-61-5 RDH)
(EURAEC-1378; EUR-2339) CFSTI: HC $1.00/MF $0.50

Radiographs were made of defects in steel test blocks and the image quality evaluated for a 5 MeV linear accelerator, a 17 MeV betatron, and a 31 MeV betatron. Other variables evaluated included the testblock thickness, film type, and thickness and position of lead or tantalum screens. NSA

N66-20464# Roentgen Technische Dienst N. V., Rotterdam (Netherlands).
NON-DESTRUCTIVE WELDING Quarterly Report No. 12, 1 Apr.–30 Jul. 1964
31 Mar. 1965 26 p Transl. into ENGLISH from DUTCH
(Contract EURATOM-045-61-5 RDH)
(EURAEC-1341; EUR-2317) CFSTI: HC $2.00/MF $0.50

Factors influencing the image quality of radiographs and means for evaluation of it are reviewed. The use of a microdensitometer for an objective evaluation is considered and results of preliminary investigations given. The correlation between visual evaluation of the image quality and measurements is envisaged. The results of previous ultrasonic investigations were analyzed in detail and supplementary tests on the test-piece 300 A–B were made. A double probe technique was applied whereby the probes were placed in tandem. With this technique, defects were revealed that were missed with the single probe technique. The double probe technique appears to be more sensitive to two dimensional defects lying nearly perpendicular to the plate surface and gives better information on defect size. Author (NSA)

N66-20488# Oak Ridge National Lab., Tenn.
NONDESTRUCTIVE TESTING OF IRRADIATED MATERIALS IN THE UNITED STATES
Robert W. McClung and Donald A. Douglas, Jr. [1965] 16 p refs Presented at the Intern. Symp. on Working Methods in High Activity Hot Labs, Grenoble, France
(Contract W-7405-ENG-26)
(ORNL-P-1109; CONF-650604-1) CFSTI: HC $1.00/MF $0.50

New demands for nondestructuve evaluation of radioactive specimens in high-activity hot laboratories have required extensive development of new techniques. Several methods using external radiation sources have needed greater development beyond that necessary for cold laboratory operation. Radiation techniques which are discussed include neutron radiography, x-radiography, gamma attenuation, and the use of x-ray sensitive television. Many other methods such as ultrasonics, eddy currents, liquid penetrants, and leak testing have been possible by making mechanical modifications to allow the test to be performed remotely. Author (NSA)

N66-20507# Oak Ridge National Lab., Tenn.
A NEW, VERSATILE VACUUM QUICK-SEAL AND VACUUM LOCK
O. D. Matlock 1965 8 p Presented at the Symp. on Eng. Probl. of Controlled Thermonucl. Res., Livermore, Calif.
(Contract W-7405-ENG-26)
(ORNL-P-1517; CONF-650512-15)

An all-metal quick seal was developed for work with microwaves. The method and sequence of assembly are described. A "quick valve" comprising a compact integral valve, lock, and pump out system is also described, along with details of its assembly to a quick seal with a wire probe. NSA

N66-20533# California Univ., Livermore. Lawrence Radiation Lab.
LEVITATION MELTING OF BERYLLIUM AND ALUMINUM
R. F. Bunshah, and R. S. Juntz Jun. 1964 13 p refs Presented at the Am. Vacuum Soc. Vacuum Met. Meeting, New York, 29 Jun.–1 Jul. 1964
(Contract W-7405-ENG-48)
(UCRL-7913; CONF-603-11) CFSTI: HC $1.00/MF $0.50

A method for levitation melting of 70–120 g charges of Al in air and 60–80 g charges of Be in a vacuum of 5×10^{-5} torr is described. Melts were cast into 1 and 1-1/2 in. dia. rods without contamination. The limitations of the technique are discussed. Author (NSA)

N66-20544# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
BRAZING FLANGES TO SINTERED, STAINLESS STEEL FILTERS FOR HIGH-TEMPERATURE SERVICE
R. G. Donnelly Oct. 1965 10 p
(Contract W-7405-ENG-26)
(ORNL-TM-1252) CFSTI: HC $1.00/MF $0.50

A procedure was developed to successfully join wrought, type 347 stainless steel flanges to sintered filters of the same alloy for service at 1300°F. The procedure consisted of presealing the joint area of the filter with a high-melting nickel-base brazing alloy and then, in a second brazing operation with a lower melting alloy, joining the flange to the presealed filter. This double brazing operation was necessary to overcome the gross absorption of brazing alloy by the sintered filter due to capillarity. Sealing of the filter joint area was accomplished by coating with a controlled quantity of the Standard Nicrobraz alloy (AMS-4775) and vacuum brazing at 2150°F for 5 min. The flange was then joined to the filter by induction brazing in an argon atmosphere with two rings of Premabraze 130 (82% Au–18% Ni, melting point 1742°F). Metallographic examination revealed that this procedure caused no detrimental effects to the filter's properties. To date, through utilization of the developed procedure, seventeen type 347 stainless steel filters have been successfully joined to wrought flanges of the same alloy. Author (NSA)

N66-20581# Marine Engineering Lab., Annapolis, Md.
SELF-LUBRICATED SEALS DEVELOPMENT FOR HIGH-PRESSURE, OIL-FREE COMPRESSORS
John R. Ward Jan. 1966 23 p refs
(MEL-399/65; AD-627230) CFSTI: HC $1.00/MF $0.50

Continued progress in the development of self-lubricated piston and rod seals for oil-free, high pressure air compressors is described. Seal material characteristics based on filled polyetrafluoroethylene (PTFE) as well as new, potentially improved seal materials are discussed. Piston speeds up to 450 feet per minute were investigated. Wear results from several long-term tests at 4500 and 5000 pounds per square inch are shown. A useful piston seal life exceeding 2000 hours was demonstrated. Author (TAB)

N66-20583# Brunswick Corp., Marion, Va. Defense Products Div.
[A STUDY OF THE A-6A (A2F-1) NOSE RADOME] Final Engineering Report, 16 Mar. 1964–1 Sep. 1965
J. F. Morrell, R. S. Ebert, and J. F. Phillips 27 Sep. 1965 28 p refs
(Contract NOw-64-0351-f)
(AD-627089) CFSTI: HC $2.00/MF $0.50

A study was made of the A-6A (A2F-1) Nose Radome, with the objective of obtaining structural improvements. Following an initial materials investigation, one radome was fabricated using a wire grid honeycomb composite bonded to the interior of the half-wave wall shell. Structural tests show that improvements in the radome may be obtained through use of this concept. Author (TAB)

N66-20644# IMC Magnetics Corp., Westbury, N. Y. Eastern Div.
DEVELOPMENT OF COOLING DEVICE Interim Development Report, 1 Jul.–30 Sep. 1965
[1963] 43 p refs
(Contract NObsr-93424)
(AD-625140) CFSTI: HC $2.00/MF $0.50

The report details progress in three areas: development of an air measuring system for air deliveries in 1–5 cubic feet per minute range, development of a miniature vaneaxial fan and early test results, and design of an air bearing system suitable for use with the miniature vaneaxial fan. Author (TAB)

N66-20697# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
ENERGY CONSUMPTION IN ELECTROHYDRAULIC CRUSHING
K. W. Carley-Macauly, J. W. Hitchon, and N. G. Maroudas Aug. 1965 48 p refs
(AERE-R-5054)

A series of experiments is described on the continuous crushing of brittle materials by means of underwater sparks. The equipment design, based on previous experiments, allowed fast discharges from an electric circuit of low inductance (0.1–0.2 μH). The main materials investigated were sintered alumina and gravel, crushed from 1 cm to give a product top size of 200–300 μ. The effect of voltage (20–85 kV), spark gap length (0.5–4 cm) and to a lesser extent capacitance (0.002–0.125 μF) have been investigated with respect to yield of product, and also to the possible limits of spark formation. The maximum yields obtained were about 20–30 kg–kWh for gravel, and 3–4 kg/kWh for sintered alumina. In both cases, there is a maximum yield at a given gap length. The crushing is though to occur by a "scabbing" mechanism and is thus influenced by the decay of shock pressure and spreading of the wave during transmission, as well as by the initial pressure and width of pulse. These features are discussed in relation both in the spark parameters, and to the observed variations in yield for which they provide a general explanation. Author

N66-20801# Technisch Documentatie en Informatie Centrum Voor de Krijgsmacht, The Hague (Netherlands).
LITERATURE SURVEY IN CHEMICAL TECHNOLOGY [LITERATUUROVERZICHT CHEMISCHE TECHNOLOGIE]
9 Feb. 1966 37 p refs *In* DUTCH, GERMAN, and ENGLISH *Its* Vol. 1, No. CT-2
CFSTI: HC $2.00/MF $0.50

Abstracts and bibliographic notes are included on the topics of coorosion, surface treatment, plastics, lubricants, materials, water and air purification, fire fighting, packaging, batteries, chemicals, and technical news. Transl. by J.O.

N66-20886*# National Aeronautics and Space Administration, Washington, D. C.
SELECTED LISTING OF TECHNOLOGY UTILIZATION PUBLICATIONS
Feb. 1966 23 p refs Including all Tech Briefs through Dec. 1965
(NASA-TM-X-57316) CFSTI: HC $1.00/MF $0.50 CSCL 13H

This information booklet on technical developments that have general industrial applications includes brief abstracts of the following publications: Advanced bearing technology; reliable electrical connections; space batteries; measurements of blood pressure in the human body; measurement of bird embryo heartbeat with a micrometeorite transducer; selected welding techniques; selected shop techniques; welding for electronic assemblies; low temperature effects on structural materials; precision tooling techniques; technology of inorganic coatings; joining and sealing of dissimilar metals; metal-forming techniques; advanced valve technology; micropower logic circuits; medical and biological applications of space technology; status of magnesium-lithium alloys; elastic orifices for gas bearings; microelectronics in space research; handling of hazardous materials; plasma jet technology; and the electromagnetic hammer. Included is a numbered Tech Brief list that covers electrical (electronic), energy sources, materials (chemistry), and life science publications. G.G.

N66-20882# New Hampshire Univ., Durham. Dept. of Mechanical Engineering.
INVESTIGATION AND ANALYSIS OF THE PERFORMANCE CHARACTERISTICS AND FLOW CIRCULATION IN A TEST MODEL REGENERATIVE PUMP
Thomas O. Engelhardt (M. S. Thesis) Jun. 1965 55 p refs
(Contract AF 33(608)-1256)
(AD-624652) CFSTI: HC $3.00/MF $0.50

The momentum analysis, even with gross assumptions of linear momentum change causing the pressure buildup, yielded results that agree with the experimental results. The characteristic curves for the test model pump are similar to published curves for regenerative pumps. Therefore, this type of momentum analysis does provide an insight into the circulation and velocity pattern that exists in conventional regenerative pumps. The circulation is very important in this theory of momentum exchange, therefore further work should be directed toward controlling the circulation to yield the desired pump characteristics. The test pump impeller design with the toroid should be compared with regenerative pumps with conventional impeller design in actual tests with other factors equalized. Author (TAB)

N66-20938*# Pratt and Whitney Aircraft, East Hartford, Conn.
BRAYTON-CYCLE TURBOMACHINERY ROLLING-ELEMENT BEARING SYSTEM Second Quarterly Report, Oct. 2, 1965–Jan. 2, 1966
Herbert E. Means Feb. 1966 95 p refs
(Contract NAS3-7635)
(NASA-CR-54915; PWA-2780) CFSTI: HC $3.00/MF $0.75 CSCL 13T

The rolling-element bearing lubrication system for Brayton cycle space power machinery was refined and defined further. The revised lubrication system is a recirculating system with a number of single-phase and two-phase flow passages. Alternate concepts were investigated but were found to involve high parasitic losses. Features of the turbine-compressor rotor support and face seals were established, and detail effort was concentrated on the rotor dynamics system and seal designs. Refinements were made in the rotor design of the turboalternator, mainly in the overhung oil–gas separator. The balancing requirements and material selections for the turboalternator were specified. Laboratory scale tests of candidate adsorber materials indicate that a practical adsorber can be made for the conditions anticipated. A five-ring polyphenyl ether was recommended for the system lubricant. N.E.N.

N66-20945*# Martin Co., Baltimore, Md.
SPACE TOOL KIT: SURVEY, DEVELOPMENT AND EVALUATION PROGRAM Final Report
Allen E. Holmes [1964] 205 p refs
(Contract NAS9-3161)
(NASA-CR-65267; ER-13942) CFSTI: HC $6.00/MF $1.25 CSCL 13I

The design, fabrication, and evaluation of prototype tools and accessories for maintenance, repair and assembly tasks in orbit, and on the lunar and Martian surfaces were completed. Tradeoffs were made, and the basic tools and accessory areas decided upon were: power torquing, sawing, and drilling; hand hammering and screwdriving; personnel restraint; work site illumination; small parts manipulation and retention; and work site layout, and tool and accessory packaging. A power tool consisting of a basic 12 V dc permanent magnet motor and handle unit was developed. All attachments work with essentially zero reaction on the astronaut worker. A study of restraint requirements led to the development of an adhesive attachment. A rigid rope, an ellipsoidal reflector work light for the helmet, and a small brush holder for small parts manipulation were also fabricated. The tools and accessories were integrated into a package 14×14×10 inches with a volume of 0.7 cubic feet. Included in the kit is a silver zinc rechargeable battery for tool power. N.E.N.

N66-20982# Wissenschaftliche Gesellschaft fur Luft- und Raumfahrt, Cologne (West Germany).
REPORT ON THE MEETING OF THE SCIENTIFIC COMMITTEE ON HEAT-RESISTANT MATERIALS AND THE WORKING COMMITTEE ON HIGHLY HEAT-RESISTANT STEELS OF THE GERMAN SOCIETY OF IRON-WORKS ON 20 OCTOBER 1964 IN DUSSELDORF [BERICHT UBER DIE SITZUNG DES FACHASSCHUSSES WARMFESTE WERKSTOFFE UND DES VDEh-ARBEITSKREISES HOCHWARMFESTE STAHLE AM 20. OKTOBER 1964 IN DUSSELDORF]
K. Bungardt 27 Oct. 1964 92 p refs In GERMAN
(DLR-65-11) CFSTI: HC $3.00/MF $0.75

Brief reviews on characteristics and applications of nickel-chromium and nickel-chromium-cobalt alloys are followed by a description of the state-of-the-art in electric art welding methods. Also presented are detailed discussions on current developments of high-temperature titanium alloys containing a high percentage of α-phase materials. New titanium alloys with high aluminum, tin, and zirconium contents proved to be very heat resistant and able to withstand temperatures of up to 550°C. The mechanical properties for a variety of technical titanium alloys are shown in tables. Calculations on the bending elasticity of very thin titanium alloy sheets of 0.1 mm established its applicability to forming processes in missile production, and the advantages of long-duration hot forming are shown for two titanium alloy sheets. The report concludes with a description of various testing methods and devices to determine the mechanical properties of high-temperature materials in a hot environment. Indirect resistance and indirect induction heating in a vacuum evolved as most suitable methods to observe creep parameters of materials exposed to a temperature range from 1200° C to 2500° C. Transl. by G.G.

N66-20984# British Hydromechanics Research Association, Cranfield (England).
A BIBLIOGRAPHY OF HYDRAULIC GATES
T. E. Brock, ed. Sep. 1965 45 p refs
(BIB-20) CFSTI: HC $2.00/MF $0.50

References and illustrations dealing with hydraulic gates are presented in a chronological bibliography. Most of the 166 references are papers or sections of books published during the last 15 years, although some earlier references are presented. Many abstracts are given, and both subject and author indexes are included. M.W.R.

N66-20988*# Martin Co., Baltimore, Md.
DESIGN STUDY FOR LUNAR EXPLORATION HAND TOOLS Third Quarterly Report
Donald S. Crouch Jul. 1965 39 p
(Contract NAS9-3647)
(NASA-CR-65270; ER-13951) CFSTI: HC $2.00/MF $0.50 CSCL 13I

Results of a design study of lunar exploration hand tools are presented. Operational and spacesuit interface tests of the first prototype powered lunar geologist tool were conducted, and design criteria were established for the second model. Additional feasibility tests were conducted for the selection of a range finder surveying instrument which will best meet the early lunar surface exploration requirements. Detail design and fabrication of a sample weighing device, hand lens, and hand-held geologist hammer were commenced. Author

N66-20991*# Martin Co., Baltimore, Md.
DESIGN STUDY FOR LUNAR EXPLORATION HAND TOOLS Final Report, 26 Oct. 1964–15 Dec. 1965
Donald S. Crouch Dec. 1965 207 p refs
(Contract NAS9-3647)
(NASA-CR-65271; ER-14052) CFSTI: HC $6.00/MF $1.25 CSCL 13I

A study of exploration hand tool requirements applicable for lunar surface operation within the constraints of early LEM missions resulted in the selection of fourteen individual items, most of which possess multi-function capabilities. Categorical functions include: (1) powered and hand-operated devices for lunar specimen extraction; (2) specimen examination aids; (3) specimen transport device; (4) specimen weighing device; and (5) topographical surveying instruments. A prototype tool kit was developed and fabricated for subsequent evaluation tests. Author

N66-20993*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
HYDRODYNAMIC JOURNAL BEARING PROGRAM Quarterly Progress Report No. 1, 29 May–29 Jul. 1965
J. D. Mc Hugh, H. E. Nichols, W. D. C. Richards, and H. C. Lee [1965] 109 p refs
(Contract NAS3-6479)
(NASA-CR-54792) CFSTI: HC $4.00/MF $0.75 CSCL 13I

Test assembly design requirements and program objectives are defined for journal bearings which possess characteristics required for use in space power systems. Requirements include long term unattended operation under zero gravity conditions using low viscosity lubricants such as potassium at 1200°F. An available test assembly was modified to permit dynamic calibration of Bently inductance type proximity probes in a water environment. The test shaft is supported on two 7207 class 5 preloaded angular contact ball bearings, lubricated with spindle oil. These Bently probes must demonstrate an accuracy of ±50 micro-inches and a zero shift within 25 micro-inches. It is reported that bench testing of the Bently probes is underway, and in addition, the testing and monitoring equipment is being set up. A high speed test rig which will be procured for the ensuing test program was designed, and the manufacturing drawings completed. In parallel with this mechanical design and testing effort, analysis of the fundamental rotor-bearing system dynamics was initiated. C.T.C.

N66-21081*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PRELIMINARY DESIGN, VOLUME A (BOOK 4B OF 4): IMPLEMENTATION PLAN
30 Jul. 1965 610 p Prepared for JPL *Its* Rept.-65SD4388
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71489) CFSTI: HC $9.10/MF $3.00 CSCL 13H

Schedule and implementation plans for the Voyager Spacecraft are discussed. These include quality assurance, safety, procurement and fabrication, magnetic cleanliness, EMI, project control, cost and schedule, hardware control, communication, facility, and interface integration plans. A review of plans for logistics, resource management, system auditing, subcontractor management, and functional management are also presented. L.S.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-19855# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AMMONIA MASER (AMMONIA MOLECULAR GENERATOR)
N. A. Begun, V. P. Yegorov, V. V. Il'in, and V. Ye. Petrov 27 Oct. 1965 7 p Transl. into ENGLISH from Soviet Patent no. 160727 (Appl. no. 790507/26-9, 8 Aug. 1962) 2 p
(FTD-TT-65-803/1+2+4; AD-625196) CFSTI: HC $1.00/MF $0.50

The object of the invention is an ammonia molecular generator with opposing beams which has the distinguishing feature that, for the purpose of lengthening the period of uninterrupted working, through the means of avoiding the deposition of particles of the active substance of a high vacuum pump on the working surfaces of the high frequency resonator, and simplification of the design of the generator through the exclusion of cryogenic substance, there are used extended multichannel pickups of the beams of the ammonia with six and eight-field sorting systems and heating of the high-frequency generator. Author (TAB)

N66-19899# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIATION BEHAVIOR OF MOLECULES IN THE DETUNING CAVITY AND OSCILLATION PHENOMENA OF A DOUBLE-CAVITY MASER
Tieh-Cheng Lee and Li-Chih Fang 6 Jan. 1966 15 p refs
Trans. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 20, no. 8, 1964 p 753-759
(FTD-TT-65-888/1+2+3+4; AD-626953) CFSTI: HC $1.00/MF $0.50

A quantum-mechanical treatment is presented of the radiation behavior of molecules in the detuning cavity. The phenomenon that was discovered by Higa (Rev. Sci. Instr., 28. 1957, p. 726) in his experiment with a double-cavity maser is explained; namely, when the detuning frequency of the first cavity reaches a certain critical value, the amonia molecules in the second cavity suddenly break out into oscillation at the central frequency. A critical formula for the detuning that excites such sudden oscillation is obtained. The influence of the cooperation effect is also taken into consideration. Also qualitatively explained is the experiment performed by Strakhovskiy et al. (J. Exp. Theor. Phys., 42, 1962, p. 907) which relates the degree of detuning in first cavity with the radiative power of the molecules in second cavity. Author (TAB)

N66-19914# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING THE RADIATION SPECTRUM OF A RUBY LASER AND ITS RELATIONSHIP WITH RESONATOR PROPERTIES
F. A. Korolev and S. M. Mamedzade 13 Jan. 1966 12 p refs
Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 2, 1965 p 35-39
(FTD-TT-65-1312/1+2+4; AD-626959) CFSTI: HC $1.00/MF $0.50

The complex Fabri-Pero standard (multiplex) in a wedge like and crossed regime was accepted for the investigation of resonant oscillation radiation types of a ruby laser at room temperature. The outer dielectric mirrors and the frontal edges of the ruby crystal constituted the complex resonator, in which various forms of oscillation originated, corresponded to various resonator components. The multiplex standard, working in wedge shaped and crossed condition with various thicknesses of thrust rings, enabled to solve components of ultra-thin structure of the ruby laser spectrum with complex resonator. Author (TAB)

N66-19918# Linde Co., East Chicago, Ind.
PRODUCTION ENGINEERING MEASURE FOR RUBY LASER RODS. Quarterly Progress Report, Jul. 1-Sep. 30, 1965
B. H. Heise [1965] 16 p
(Contract DA-36-039-AMC-06168(E))
(QPR-1; AD-626212) CFSTI: HC $1.00/MF $0.50

The document reports progress toward improving the ruby growth process for the manufacture of Rangefinder laser rods. The work of the first quarter involved procurement of equipment, preliminary growth of crystals, improvement of growth apparatus, and initial runs investigating individual variables of the Verneuil growth process. Preliminary growth was performed: viz., shakedown for the two stations assigned to the project, and determination of the present status of crystal growth performed on two additional stations on temporary loan. The crystals produced in the latter investigation await evaluation. A means for accurately controlling the distance between the boule cap and the burner head was devised and installed and is now operating satisfactorily. A means for obtaining a continuous flow of powder was devised. This apparatus will be installed and tested on a growth station during the next quarter. Investigations of the effect of varying the diameter of the boule and the distance between the boule cap and the burner are well under way. Crystals produced in these investigations now await evaluation. All items on the critical path of the PERT diagram are on or ahead of schedule. Fabrication and active evaluation are temporarily behind schedule but these items do not lie on the critical path. Author (TAB)

N66-20171# Polytechnic Inst. of Brooklyn, N. Y.
ORGANIC LUMINESCENT MATERIALS FOR OPTICAL MASERS Final Report, 1 Apr. 1963-30 Jun. 1965
Gerald Oster 13 Dec. 1965 47 p refs
(Contract Nonr-839(36); ARPA Order 306-36; Proj. Defender)
(AD-626314) CFSTI: HC $2.00/MF $0.50

The luminescence properties of aromatic hydrocarbons in plastic matrices were examined. The relation between luminescence and photoconductivity of zinc oxide and its dependence on environmental factors was established. A fluorescein plastic having properties indicative of induced emission was made and tested. A new method for determining the degree of coherence of non-monochromatic light sources was devised. Author (TAB)

N66-20322# Sandia Corp., Livermore, Calif.
FRINGE COUNTING LASER INTERFEROMETERS FOR INDUSTRIAL LENGTH MEASUREMENT
J. D. Foster (Ph.D. Thesis—Calif. Univ., Berkeley) Sep. 1965 204 p refs
(Contract AT(29-1)-789)
(SCL-DC-65-92) CFSTI: HC $6.00/MF $1.25

The use of fringe-counting Michelson interferometers for length measurement has been restricted due to the problems of short measuring range and sensitivity to disturbance. The helium–neon gas laser is shown to be the answer to these problems. Use of the gas laser is shown to remove the measuring range limitations and to permit the design of solid integral interferometer systems with ruggedness and reliability, which allows their use in normal industrial environments. A theoretical model for the Michelson interferometer illuminated with a helium–neon gas laser (laser interferometer) is presented. Calculations of the variations in interference fringe visibility as a function of measuring distance made with this model are shown to agree with experiment. Design considerations for stabilized single-frequency laser cavities are given. A solid integral interferometer system with fringe counting electronics is described. Experimental results are given, which demonstrate the accuracy and long-range measuring capabilities of the system. Author (NSA)

N66-20355# California Univ., Livermore. Lawrence Radiation Lab.
THEORY OF COUPLED-MODE LASER OSCILLATIONS
J. A. Fleck, Jr. and R. E. Kidder 8 Apr. 1964 33 p refs
(Contract W-7405-ENG-48)
(UCRL-7497) CFSTI: HC $2.00/MF $0.50

A set of general equations describing the time-dependent behavior of a laser is derived. The derivation is based on a density matrix description of the occupation of a pair of homogeneously broadened laser levels and a semi-classical treatment of the radiation field, consisting of an arbitrary number of modes. The resulting equations resemble ordinary rate and energy conservation equations but contain additional interference terms which, in general, couple all of the modes. The strength of this coupling depends on the inhomogeneity of the population inversion as well as on the mode frequencies. The energy conservation equations imply that absorption and stimulated emission in such a system can apply, strictly speaking, only collectively to the system of modes as a whole. Stability analysis carried out in the two-mode case indicates that a spatial inhomogeneity in the pumping rate is required for undamped oscillations. It is also concluded that coupling of off-axis modes is more likely to lead to undamped spiking than coupling of axial modes. Author (NSA)

N66-20368# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
STIMULATED COMPTON SCATTERING OF ELECTRONS BY LASER BEAM
L. S. Bartell and H. Bradford Thompson 4 Jul. 1965 8 p refs Presented at the Phys. of Quantum Electron. Conf., San Juan, Puerto Rico, 28–30 Jun. 1965
(Contract W-7405-ENG-42)
(S-1187; CONF-650638-1) CFSTI: HC $1.00/MF $0.50

The scattering of a beam of electrons by intense standing waves of photons inside a laser cavity was recently observed. It is believed that this scattering corresponds to the stimulated Compton effect predicted by Kapitza and Dirac many years ago. The analogy between this effect and its inverse, the scattering of photons by a periodic lattice of electrons, is discussed along with several experimental observations and possible applications. Author (NSA)

N66-20553# Brookhaven National Lab., Upton, N. Y.
LASER FLASH TUBE TRIGGERING SYSTEM
D. Stephani 3 Jun. 1965 6 p
(Contract AT(30-2)-GEN-16)
(BNL-9257) CFSTI: HC $1.00/MF $0.50

A circuit is designed to fire Xe flash tubes used in a laser system. An Al reflector, which completely encircles the laser crystal and the flash tubes, is grounded. A small wire loop is wrapped around the flash tube at the ground, just above the grounded electrode. This wire is coupled to the high voltage pulsed electrode through 50 pf. This expedient produces reliable firing of the flash tubes for high voltage supplies of 800 to 2800 V. In the configuration used, four flash tubes are spaced uniformly around the laser crystal, and the described circuit is used to fire all four of the tubes. NSA

N66-20809# Radio Corp. of America, Princeton, N. J. RCA Labs.
ROOM TEMPERATURE LASER DIODES First Quarterly Report, Jul. 1–Sep. 30, 1965
George C. Dousmanis, Aline Akselrad, and Herbert Nelson Ft. Monmouth, N. J., Army Electron. Command, Oct. 1965 21 p refs
(Contract DA-28-043-AMC-01501(E))
(ECOM-01501-1; AD-626775) CFSTI: HC $1.00/MF $0.50

The performance of pulsed GaAs injection lasers has been studied at repetition rates as high as 30 kc/sec with 80-nsec-wide pulses. Peak power outputs of 10 watts are obtained with 40 A at low repetition rates (0.1 to 10 kc/sec). At 30 kc/sec the power output is 4.5 watts. These results apply to the conventional parallelepiped structure (junction width approx. 0.0075 cm and length 0.025 cm). The experimental results up to 30 kc/sec suggest power outputs of about 1 W at 100 kc/sec, despite some temperature rise with repetition rate indicated by approximate calculations on heating effects. A new 'line diode' structure is described which embodies a large area p-n junction but with a lasing region width of less than 0.0025 cm. An improved performance is expected at high repetition rates from these units. Author (TAB)

N66-20850# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
DYNAMIC STRESS CONCENTRATION USING PHOTOELASTICITY AND A LASER LIGHT SOURCE
W. P. T. North and C. E. Taylor Sep. 1965 23 p refs
(Grant NSF GK-70)
(T&AM-285)

Since experimental techniques using dynamic photoelasticity are in general limited by suitably intense monochromatic light sources, it was of primary importance to describe a ruby laser system which would completely remove this particular aspect of the problem. Modulation of the system, in this case by a Kerr cell, provides the necessary control of the light output such that a complete series of results can be obtained by putting together the results of many individual tests recorded on a conventional still camera. In this case the dynamic stress concentration factor in a strut with a symmetrically located circular discontinuity was determined to definitely establish the potential of the system. Author

N66-20857# Frankford Arsenal, Philadelphia, Pa. Research and Development Directorate.
BASIC THEORETICAL CONSIDERATIONS OF LIGHT AMPLIFICATION BY STIMULATED EMISSION OF RADIATION
Alexander J. Casella Nov. 1964 56 p refs
(R-1743; AD-612516) CFSTI: HC $3.00/MF $0.75

A theoretical development of the basic physical principles of Light Amplification by Stimulated Emission of Radiation (LASER) is presented. The processes of absorption and emission are presented in a general manner, using both a classical and quantum mechanical approach. The classical approach involves the approximation of the motion of an atomic electron as a driven oscillator. The quantum mechanical approach employs the time-dependent perturbation approximation to develop the transition rates for absorption and emission. A brief discussion of the lifetime and spectral line width of excited energy states is presented due to their importance in considerations of the LASER. Following this general development of the absorption and emission processes; a qualitative discussion of the important aspects of the LASER mechanism is presented. A quantitative development of the conditions for amplification for the two basic types of LASER (the three-level and four-level types) is presented using ruby and neodymium-doped glass as typical examples. Author (TAB)

N66-20941*# Radio Corp. of America, Camden, N. J.
LASER COMMUNICATION TRANSMITTER Final Report
Nov. 1965 54 p
(Contract NAS9-4473)
(NASA-CR-65246) CFSTI: HC $3.00/MF $0.50 CSCL 20E

The objective of this program was to design and fabricate three injection laser transmitters to be used as part of the GT-7 Gemini experiments. One transmitter will be used by an astronaut to establish an experimental laser communication link with a ground receiving station at White Sands missile range. The remaining units will be used for qualification tests and as back-up units. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-19815# Dayton Univ., Ohio.
X-RAY DIFFRACTION STUDY OF THE OXIDATION OF Ta, Nb, AND SOME Nb ALLOYS AT ATMOSPHERIC PRESSURES Technical Report, Jun. 1962–Jul. 1965
Robert O. Nunemacher and Mark A. Goldschmidt Wright-Patterson AFB, Ohio. AF Mater. Lab., Nov. 1965 32 p refs (Contract AF 33(657)-8553)
(AFML-TR-65-332; AD-626990) CFSTI: HC $2.00/MF $0.50

The oxidation characteristics of niobium and tantalum powders and niobium, tantalum and certain niobium alloys were determined by X-ray diffraction techniques. The various color changes in the suboxide range of the powders during air oxidation were investigated. Diffraction data is given for the low temperature alpha and for the high temperature beta Nb_2O_5 phases. No new gamma phase of Nb_2O_5 formed after extensive heating at 800C. Oxidation rates are reported for Nb and Ta sheet and three Nb alloys: CB-752 (10 W, 2.5 Zr), D-43 (10 W, 1 Zr), and D-36 (10 Ti, 5 Zr). The D-36 alloy exhibited the greatest resistance to oxidation. Author (TAB)

N66-19887# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 294
1 Mar. 1966 31 p refs Transl. into ENGLISH from Chin Shu Hsueh Pao (Peking), v. VIII, No. 1, Jan. 1965 p 93–96, No. 2, Apr. 1965 p 232–236, 284–285, and No. 3, Jul. 1965 p 392–394
(JPRS-34332; TT-66-30773) CFSTI: $2.00

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2. A STUDY OF THE INTERACTION OF DISLOCATIONS WITH PRECIPITATES IN NICKEL-BASE HIGH TEMPERATURE ALLOYS C. Ch'ih, S.-s. Ting, and H.-w. Wang p 8–19 refs (See N66-19889 10-17)

3. OXYGEN CONTAMINATION FROM CRUCIBLE IN BATCH-TYPE VACUUM INDUCTION MELTING H.-h. Shao, C. Shui, J.-c. Chao, and P.-h. Ch'u p 20–24 refs (See N66-19890 10-17)

N66-19888 Joint Publications Research Service, Washington, D. C.
THE TEXTURE AND MAGNETOSTRICTION OF NICKEL
Hsin-Yu Chang, Yu-Lien Ch'en, and Li-Chih Tai *In its* Transl. on Communist China's Sci. and Technol., No. 294 1 Mar. 1966 p 1–7 refs (See N66-19887 10-17) CFSTI: $2.00

The relationships between recrystallization texture of pure nickel, cold rolled material, and magnetostriction are described. An X-ray scattering instrument was used to measure texture after intensive cold rolling. Varying durations of heat treatment were applied and then annealing temperature was increased to 1350°C to measure recrystallization texture at various annealing states. Simple cubic texture was formed after deformation texture disappeared with increases in annealing time. The recrystallization dynamics of deformation texture are indicated to be closely related to the types of deformation texture. After cold rerolling of the cubic oriented nickel samples, through the 93% elongation rate, deformation texture appeared. The strain electric-resistance method was used for magnetostrictive measurement. Magnetostrictive curves are given for the samples after cold rolling with different elongation rates. E.A.O.

N66-19889 Joint Publications Research Service, Washington, D. C.
A STUDY OF THE INTERACTION OF DISLOCATIONS WITH PRECIPITATES IN NICKEL-BASE HIGH TEMPERATURE ALLOYS
Ch'en Ch'ih, Shu-Shen Ting, and Hsiu-Wen Wang *In its* Transl. on Communist China's Sci. and Technol., No. 294 1 Mar. 1966 p 8–19 refs (See N66-19887 10-17) CFSTI: $2.00

The dislocation-tangented precipitation phase is studied in nickel base high temperature alloys. According to the orientation relationship between the gamma prime phase and the base body, the crystal structure and the distribution form infer that the dislocation will be tangent to the gamma prime phase and the carbonate conditions are opposite. Surface observations of the alloy after normal heat treatment showed dislocation tangent to the gamma prime phase. The gamma prime phase was examined under conditions of instantaneous and persistent deformation by X-ray and optical analysis. The slip plane of Ni_3Al crystal was measured and was consistently (111). Crystallographic conditions of the dislocation-tangented precipitation phase are stated: (1) Between the base body and the precipitation phase, there is a common slip surface. (2) The difference between Poynting vector of dislocation of the base body and the precipitation phase is small, or total dislocation of the base body is half dislocation in the precipitation phase. The theory of tangented dislocation is discussed. E.A.O.

N66-19890 Joint Publications Research Service, Washington, D. C.
OXYGEN CONTAMINATION FROM CRUCIBLE IN BATCH-TYPE VACUUM INDUCTION MELTING
Hsiang-Hua Shao, Chih Shui, Jen-Ch'uan Chao, and P'ei-Hsun Ch'u *In its* Transl. on Communist China's Sci. and Technol., No. 294 1 Mar. 1966 p 20–24 refs (See N66-19887 10-17) CFSTI: $2.00

The problem of oxygen contamination from an oxide crucible is considered for batch-type vacuum induction smelting. Several types of magnesium oxide crucibles are described for smelting pure nickel under different conditions. Experiments were performed to determine the oxygen sources during the melting period and after melting. A slow oxygen supply after melting is due to dissociation of the magnesium oxide. However in the melting period and a short time afterward the oxygen contamination is attributed to the dissociation of melt oxide formed by the breaking of the vacuum after the melting of previous batches. The formed oxide is recharged into the melting bath and becomes a source of oxygen in addition to the dissociation of the magnesium oxide. Heating in a vacuum may possibly cause the NiO in the crucible pores to dissolve. It is recommended that continuous-type vacuum induction furnaces be used to avoid contamination from melt oxides. E.A.O.

N66-19915# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLASMA JET ATOMIZATION OF MOLYBDENUM
A. N. Krasnov 13 Jan. 1966 12 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), no. 3, 1965 p 1–5
(FTD-TT-65-1381/1+2+4, AD-626961) CFSTI: HC $1.00/MF $0.50

The results are presented of an investigation of the effect of variable parameters of the process of plasma atomization on the granulometric composition of the resulting molybdenum powder. Author (TAB)

N66-19927# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).
THE USE OF TRITIUM AS A TRACER IN STUDIES OF HYDROGEN UPTAKE BY ZIRCONIUM ALLOYS
B. Cox and C. Roy Dec. 1965 36 p refs
(AECL-2519) CFSTI: HC $2.00/MF $0.50

Results are given of experiments to determine the conditions under which tritium is absorbed or released by specimens during oxidation, and thereby to attempt to elucidate the mechanism of hydrogen uptake. It was concluded that: (1) Hydrogen cannot be incorporated in oxide films on zirconium alloys either by heating in hydrogen or by cathodically treating specimens in aqueous solution. (2) Results continue to support an explanation whereby the hydrogen gradient in pre-transition oxide films on Zircaloy-2 is negligible and diffusion through the oxide film is not the controlling process in hydrogen uptake. (3) The tritium distribution in oxide films on Zr-2.5 wt%. (4) When heated in mixtures of T_2 and H_2O zirconium alloys absorb no tritium until sufficient exchange between the two species has occurred for tritium to be absorbed from the aqueous phase. Author

N66-19940# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.
EFFECT OF CERTAIN PROCESS VARIABLES ON VAPOR DEPOSITED TUNGSTEN
Frederick W. Hoertel 1966 23 p refs
(BM-RI-6731) 1966 23 p refs

The effects of certain process variables on the grain size, grain type, and microhardness of vapor-deposited tungsten were established, and the near-optimum parameters and the efficacy for the vapor deposition process were determined. No significant change in the grain size or microstructure resulted from ultrasonic vibration of the substrate during deposition, from variations in the hydrogen (H_2) to tungsten hexafluoride (WF_6) ratio, or from small increases in reaction-chamber pressure. Near-optimum conditions were continuous deposition at atmospheric pressure, a deposition rate of 2-mils thickness/square inch of substrate area/hour, a temperature of 550°C, and a hydrogen to WF_6 ratio of 4:1. The addition, individually, of about 2 volume-percent of butane, 24 volume-percent of carbon dioxide, or 4 volume-percent of propane to the hydrogen and WF_6 mixture produced deposits with the finest grain size for each gas. A corresponding increase in microhardness accompanied the decrease in grain size. The addition of these gases did not alter the columnar microstructure found in vapor-deposited tungsten. Author

N66-20005# Battelle Memorial Inst., Geneva (Switzerland).
THE EFFECT OF RADIATION ON THE DUCTILE-BRITTLE TRANSITION IN PRESSURE VESSEL STEELS
E. Anderson, W. Bollman, D. G. Brandon, D. L. King, M. Malone et al Brussels, EURATOM, 1965 48 p refs
(Contract EURATOM-095-62-12 RDS)
(EUR-2354.e; EURAEC-1394) CFSTI: HC $2.00/MF $0.50

The principal results obtained during the pre-irradiation study of Armco iron and the binary alloys of iron with chromium, manganese and silicon are briefly discussed. The relationship between twinning and brittle fracture has been clarified. The 1 at. % manganese and 1 at.% silicon alloys are more ductile than Armco iron, while the alloys containing up to 4 at. % chromium are more brittle. At temperatures down to 171°K manganese and chromium have little effect on the lower yield stress. At room temperature and 219°K there is no change. The effect of the alloying elements on the flow stress has also been analyzed. The propagation of Laders bands seems to be controlled by the grain boundaries. The results of studies using optical microscopy, X-ray diffraction, and electrical resistivity are also presented. The self shielding effect for the irradiation experiments of this program has been estimated and found to be acceptably small. Author

N66-20016# New Hamshire Univ., Durham. Dept. of Mechanical Engineering.
THE EFFECTS OF CYCLIC STRESSING ON PREFERRED ORIENTATION OF POLYCRYSTALLINE ALUMINUM
George Noburu Yamamoto (M.S. Thesis) Jun. 1965 40 p refs
(Contract AF 33(608)-1256)
(AD-624651) CFSTI: HC $2.00/MF $0.50

In spite of having caused severe macroscopic transgranular plastic deformation, the push-pull cyclic loading process does not appear to produce preferred orientation of the surface layers. Further, the surface morphology does not appear to be conclusively related to pre-existing preferred orientations. Conclusions are based on commercially pure aluminum, a metal with unusually high stacking fault energy, so that they should not be extended to other face-centered-cubic metals that twin easily such as copper and austenitic stainless steel. Since the deformation extends across grain boundaries future efforts might well be devoted to oriented metallographic studies comparing grain boundaries before and after cyclic stressing. Such studies may reveal much about the slip geometry. Author (TAB)

N66-20026# Koninklijke Marine, The Hague (Netherlands). Verfcommissie.
THE INFLUENCE OF PAINTS WITH A HIGH ZINC CONTENT ON THE WELDING OF A52 STEEL [DE INVLOED VAN ZINKRIJKE VERVEN OP DE LASBAARHEID VAN STAAL A 52]
H. F. M. Frohn Sep. 1965 25 p In DUTCH
(AT-1959/69; TDCK-43691) CFSTI: HC $1.00/MF $0.50

Research was conducted to determine what effect corrosive-resistant paints with a high zinc content had on the welding of A52 steel. Also considered were such mechanical properties of welding bonds, as crack values, strength of V-shaped seam connection, cross welding connections, and fatigue strength. Results showed no adverse effects from applications of 15 to 18 microns of the protective paint. The influence of the spraying materials (steel bits and copper remnants) was also checked, with no major effects detected. Epoxy resin and chlorine rubber based paints are compared, and the recommendation is made that a primary coat of an epoxy resin paint with a high zinc content be applied during ship construction. Transl. by J.O.

N66-20041# Commissariat a l'Energie Atomique, Paris (France).
SINTERED URANIUM OXIDE: SINTERING TECHNIQUES AND BEHAVIOR UNDER IRRADIATION Final Report, 1963 [OXYDE D'URANIUM FRITTE: TECHNIQUES DE FRITTAGE, COMPORTMENT SOUS IRRADIATION Rapport Final 1963]
Brussels, EURATOM, 1965 109 p refs In FRENCH; ENGLISH Summary
(Contracts EURATOM-031-60-10 RDF; EURATOM-086-62-4 RDF)
(EUR-2314.f) CFSTI: HC $4.00/MF $0.75

The direct reduction of U_3O_8 by a reducing gas gives UO_2 powders suitable for sintering in hydrogen. In order to obtain high reactivity powders, the hydrogen passing through the furnace must be diluted with an inert gas and the reaction temperature lowered at the same time. By a slow increase to

the sintering temperature densities of 95% are obtained. The use of a sintering atmosphere consisting of hydrogen with a 40 mg/l moisture content leads to a systematic density increase generally in excess of 0.1 g/cm^3. The apparent heat conductivity of the sintered UO_2 was studied in detail in a cylindrical geometry up to about 2400°C. Analysis of the curves obtained reveals the effect of additional thermal resistances due to circumferential fractures. The results of the out-of-pile measurement of the apparent coefficients for xenon diffusion in previously irradiated UO_2 showed marked scatter. The measurements carried out in an in-pile loop are much more reproducible and show that the fission gas release phenomena are higher. It is suspected that the true surface of the samples plays a major role in the evaluation of the fission gas release rates. Author

N66-20051*# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy.
MODIFIED EUTECTIC ALLOYS FOR HIGH TEMPERATURE SERVICE Semiannual Progress Report
S. F. Ramseyer and J. F. Wallace Dec. 1965 24 p
(Grant NsG-639)
(NASA-CR-70783) CFSTI: HC $1.00/MF $0.50 CSCL 11F

A study of the modification of high temperature eutectic structures of superalloys was undertaken to improve both their stress rupture and room temperature tensile properties. The aim of the research is to improve these properties by changing the normal plate, rod or needle-like eutectic structure, with its planes of brittleness, to a modified, finer, more dispersed morphology. It is shown that modification exerts a beneficial increase on nickel and cobalt alloys containing 35, 40, and 45% tungsten. This modification was also successful in producing beneficial results with the Ni-50W alloy, but failed to do so for the Co-50W alloy. Modification generally replaced the lamellar eutectic structure with a mixture of primary dendrites, more or less finely divided globular carbides and small islands of finely divided eutectic. The modified structures produced about a tenfold increase in time-to-fracture at 15,000 psi initial stress at 1800°F in air. The ductility at 1800°F was also markedly improved by this modification. M.R.W.

N66-20090 Technical Univ. of Istanbul (Turkey).
A STATISTICAL DESCRIPTION OF DISTRIBUTION OF PHASES [FAZ DAGILIMININ STATISTIK OLARAK BELIRLENMESI]
Dogan E. Gucer *In its* Bull. of the Tech. Univ. of Istanbul 1965 p 107-125 refs (See N66-20086 10-34) CFSTI: HC $4.00/MF $0.75

An attempt has been made to apply the theory of runs of mathematical statistics to the quantitative description of the state of distribution of phases. In a multi-phase alloy any deviation from the state of most probable distribution is taken as an indication of the presence of assignable causes in the statistical sense. From the metallurgical point of view these causes may be chemical, physical or mechanical in nature. Three states of distribution are distinguished: segregated, random and dispersed. A statistical parameter is defined to indicate the degree of segregation or dispersion. This report deals with the theoretical considerations only. Author

N66-20093# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENT IN THE USE OF EI893 ALLOY FOR GAS-TURBINE BLADES
L. B. Getsov, V. Ye. Shovkun, and M. A. Filatova 17 Nov. 1965 13 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 2, 1965 p 30-32
(FTD-TT-65-1025/1+2+4; AD-625290) CFSTI: HC $1.00/MF $0.50

Nine induction melted billets of the nickel based alloy EI893 were analyzed for their mechanical properties after heat treatment in accordance with standard procedures, and for their structural stability after long aging at 700° and 750°C. All samples showed high heat-resistance properties at temperatures of 750° to 800°C, with lasting plasticity as well as structural stability. Fatigue strength tests on smooth and notched specimens found the fatigue limit for 10^8 cycles of smooth specimens at 700° and 750°C exceeding $\delta_{-1} > 37$ kG. mm^2 and for specimen with notches as $\delta_{-1} > 26$ kG. mm^2. Gas turbine blades from the alloy EI893 were stamped out on a crankshaft press of 1,600 tons at 1,180°C with good results. Stamped out pieces obtained at the lower temperatures 1050°C to 1150°C showed pronounced irregularities in the granularity of their surface structures. G.G.

N66-20211# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
PROPERTIES OF COPPER ALLOYS OF HIGH RESISTANCE AND HIGH CONDUCTIVITY [PROPIEDADES DE UNA ALEACION DE COBRE DE ALTA RESISTENCIA AL ABLANDAMIENTO Y ALTA CONDUCTIVIDAD]
D. Obrutsky (Facetyt S.A.), M. Sarrate, and O. Wortman 1965 14 p refs In SPANISH Submitted for publication *Its* Informe No. 146
(NP-15530)

The precipitation in Cu-Zr alloys with various concentrations of Zr was studied using hardness tests, conductivity, thermal electromotive force, dilatometry, X-rays, and cutting. The tests verified that additions of 0.08% Zr increase significantly the recrystallization temperature. The maximum increase of hardness was observed for aging for 5 minutes at 500°C. Apparently only one mechanism is responsible for the aging. The precipitated samples have a characteristic Widmanstatten structure. The mechanical properties are dependent on the orientation and this dependency is larger when the concentration of Zr is largest. The activation energy for the precipitation was 23000 cal/mole. The mechanical properties are comparable and the conductivity is superior to alloys of Cu-Cr. NSA

N66-20240# MSA Research Corp., Callery, Pa.
EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS Progress Report No. 52, Dec. 1964
R. C. Andrews and K. R. Barker 14 Jan. 1965 30 p
(Contract AT(11-1)-765)
(MSAR-65-05) CFSTI: HC $2.00/MF $0.50

Some data are presented for Test 3 (Type 316 stainless steel in 1200°F high-carbon sodium) and Test 5 (Type 316 stainless steel in 1200°F high-oxygen sodium). The data include creep-rupture tests, fatigue tests, and impact tests. The status of the other tests is also reported. Metallurgical examinations are also described. Special fatigue runs were made on Type 304 stainless steel sheet in 1200°F air and high-oxygen sodium at 1.0 and 2.5% strain. NSA

N66-20246# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

HIGH-TEMPERATURE CHEMICAL STABILITY OF REFRACTORY-BASE ALLOYS IN HIGH VACUUM

D. T. Bourgette [1965] 23 p refs Presented at the 8th Ann. Conf. on Vacuum Met., New York, 21–23 Jun. 1965

(Contract W-7405-ENG-26)

(ORNL-P-1394; CONF-650617-1) CFSTI: HC $1.00/MF $0.50

Evaporation losses of refractory-base alloys having the commercial designations T-111, FS-80, FS-85, B-66, C-129Y, and D-43 were determined for various periods of time at temperatures between 1200° and 1500° C. The experimental pressures ranged from 7×10^{-7} to 6×10^{-10} torr. In general, there were no serious evaporation problems associated with these alloys, especially at temperatures of 1200° to 1300° C. The alloys that exhibited the greatest evaporation losses contained the higher vapor pressure elements such as vanadium, zirconium, and hafnium. For example, B-66, the most volatile alloys studied, lost 1.70 mg/cm^2 at 1500° C and 7×10^{-9} torr in 316 hr, while at 1200° C and 6×10^{-10} torr a weight loss of 0.077 mg/cm^2 was measured in 513 hr. Vanadium and zirconium losses contributed 95% of the total weight loss. Evaporation occurred only at the surfaces; no subsurface voids were detected nor did evaporation occur at any preferential sites, such as grain boundaries or impurity inclusions at or near the surfaces. The total weight change in the specimens appeared to be pressure and composition dependent. At 1200° to 1300° C and 10^{-7} torr, the niobium-base alloys FS-80 and D-43, containing only zirconium as the evaporating element, showed a weight gain, while at the same temperature at 10^{-9} torr a weight loss was observed. This behavior is attributed to interstitial contamination at 10^{-7} torr and purification at 10^{-9} torr. For those alloys containing more than one evaporating species, such as B-66 and C-129Y, a weight loss was observed at both the high and low test pressures at 1500° C. The evaporation losses in these cases overshadowed the changes in the interstitial contents. Changes in the interstitial concentrations were dependent on the pressure. At 1500° C and pressures of 10^{-9} torr or lower, carbon was retained while oxygen, nitrogen, and hydrogen were evolved. At a higher pressure of 10^{-7} torr and 1500° C, carbon was lost while the oxygen and nitrogen contents showed an increase. It is believed that the reaction of carbon and oxygen resulted in the loss of carbon at the higher pressures, while at 10^{-9} torr insufficient oxygen was present to appreciably reduce the carbon concentrations. Author (NSA)

N66-20261# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

HYDRIDE AND BASAL POLE FIGURES IN ZIRCALOY-2 BY QUANTITATIVE METALLOGRAPHY

M. L. Picklesimer and P. L. Rittenhouse [1965] 26 p refs Presented at the 19th AEC Metallographic Group Meeting, 20–22 Apr. 1965

(Contract W-7405-ENG-26)

(ORNL-P-1266; CONF-650414-13) CFSTI: HC $2.00/MF $0.50

A technique was developed for rapidly determining by quantitative metallography the pole figure of hydride plates in Zircaloy 2 and the basal pole figure of close-packed hexagonal metals. Approximately 200 trace angles are measured on each of three orthogonal surfaces, and smoothed histograms of the data are plotted. A trial-and-error approximation is made using these data to determine the pole figure. An eyepiece goniometer equipped with electrical read-out is used to measure and record the angle between specific reference directions and the traces of the hydride plates on the specimen surfaces. A polarized light metallurgical microscope equipped with a sensitive tint plate and electrical read-out of stage angle is used for locating and recording the basal plane trace in close-packed-hexagonal metals. The trace angle data in both determinations are collected on an x–y recorder with a remote pen action at a rate of 500 to 800 points per hour. Normally, the pole figure can be determined with sufficient accuracy in less than two hours on metallographically prepared specimens. The techniques will permit an easier quantitative study of preferred orientation in close-packed-hexagonal metals and determination of the interrelationships between stress axis, crystallographic preferred orientation, and stress orientation of precipitated hydrides in Zircaloy 2. Author (NSA)

N66-20295# MSA Research Corp., Callery, Pa.

EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. MECHANICAL PROPERTIES OF METALS Quarterly Progress Report, Apr.–Jun. 1965

6 Aug. 1965 66 p ref

(Contract AT(11-1)-765)

(MSAR-65-96) CFSTI: HC $3.00/MF $0.75

Specimens of type 316 stainless steel in high-carbon sodium formed carbide films that reduced the ductility, fatigue life, and impact strength and increased the creep-rupture strength. The degree of carburization of the loop piping appeared to be a function of the downstream distance from the carbon bed. Data from tests in high-oxygen sodium are more scattered and show little difference in the effects on rupture life and creep rates. The impact strength decreased, but not as great as in high-carbon environments. Fatigue tests show a differently shaped failure-versus-time curve than those in other environments. This is attributed to oxygen scaling. NSA

N66-20300# MSA Research Corp., Callery, Pa.

EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS Progress Report No. 55

13 Apr. 1965 15 p

(Contract AT(11-1)-765)

(MSAR-65-47) CFSTI: HC $1.00/MF $0.50

The effects of high temperature sodium, and normally anticipated contaminants, upon the tensile, creep, creep-rupture, fatigue, and impact properties of Type 316 stainless steel and 2-1/4 Cr-1 Mo steel were investigated. Preliminary interpretations of the results indicate that carbon contamination in sodium will significantly reduce the fatigue life and the impact strengths, increase the rupture life, but reduce the ductility of 316 stainless steel. Results on 316 stainless steel in 1200°F, high (300 ppm) oxygen sodium indicate only a slight increase in the rupture strengths with a corresponding decrease in ductility. A slight decrease in the minimum creep rate was also observed. NSA

N66-20301# Iowa State Univ. of Science and Technology, Ames.

THE EFFECT OF STRAIN RATE AND TEMPERATURE ON THE DUCTILITY OF PURE AND HYDROGENATED VANADIUM

Ralph Hurley Van Fossen, Jr. (M.S. Thesis) Feb. 1965 60 p refs

(Contract W-7405-ENG-82)

(IS-T-7) CFSTI: HC $3.00/MF $0.75

Ductility surfaces were determined for pure and hydrogenated vanadium in the temperature range 77–297°K at strain rates from 0.001 min.$^{-1}$ to 5.4 min.$^{-1}$. By taking the

difference between these two surfaces, an embrittlement surface was determined, showing the temperature-strain rate variation in degree of embrittlement conferred on vanadium by hydrogen. The embrittlement surface can be defined by two domains, which correspond exactly with those found for hydrogen embrittlement of steel. It was concluded that the same basic mechanism of hydrogen embrittlement is operative in both steel and vanadium. The results indicate that hydrogen in solid solution causes the embrittlement of vanadium. Because hydrogen does not affect the yield stress or flow stress of vanadium in the region of greatest embrittlement, however, it was concluded that hydrogen must lower the cohesive strength of the material. This was found to be consistent with an existing theory on hydrogen embrittlement. It is suggested that hydrogen ions in tetrahedral interstices in vanadium causes a decrease in metal-metal bond strengths across {100} planes. NSA

N66-20319# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

COMPARISON OF POLE FIGURE DATA OBTAINED BY X-RAY DIFFRACTION AND MICROHARDNESS MEASUREMENTS ON ZIRCALOY-2

P. L. Rittenhouse and M. L. Picklesimer [1964] 20 p refs Presented at the Appl. of X-Ray Diffraction in the Atomic Energy Field Meeting, Richland, Wash.

(Contract W-7405-ENG-26)

(ORNL-P-1165; CONF-650210-3) CFSTI: HC $1.00/MF $0.50

A rapid and semiquantitative method of determining preferred orientation on large numbers of Zircaloy-2 specimens was desired. Knoop microhardness measurements were investigated as a solution to this problem. The variation of Knoop microhardness measurements on selected planes as a function of indenter axis relative to crystallographic or fabrication directions was determined for four lots of polycrystalline Zircaloy-2, on which both conventional and inverse pole figures had been determined, and seven Zircaloy-2 single crystals. Data from the single crystals were used to construct a polar coordinate hardness contour map. With use of an empirical relationship between the single crystal hardnesses and those of the polycrystalline material conventional pole figures could be constructed that compare favorably with those determined by X-ray diffraction. A quantitative relationship with inverse pole figure data was also obtained. To determine preferred orientation qualitatively from hardness data requires a minimum of twelve measurements per plane on three, preferably orthogonal, planes. The exact procedure requires attention to grain size, specimen preparation, and indenter load. The time required for preparation, measurement, and analysis is of the order of 45 to 60 min. Author (NSA)

N66-20320# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center.

DEFECTS IN CRYSTALS Annual Report, 15 Mar. 1964–15 Feb. 1965

A. S. Nowick [1965] 84 p refs

(Contract AT(30-1)-2811)

(NYO-2811-23) CFSTI: HC $3.00/MF $0.75

Anelastic relaxation in solid solutions of Ag–Zn was used to follow vacancy annealing. A plastic deformation of 2% and a lowering of the prior annealing temperature increased the rate of vacancy annealing. Vacancy interactions appear to play a minor role in vacancy annealing and oxygen contamination effects were inconclusive. Indications are that phase changes spoil the effect of a high temperature heat treatment. The existence of a dilatational irreversibility and the use of different exchange gases complicated the results obtained from the high-precision interferometric dilatometer and X-ray equipment used in the equilibrium studies of point defects in sodium. Tentative conclusions are that interstitials rather than vacancies are the predominant defect. An extension of a theory based on the thermodynamics of defect relaxations previously developed, which used the various types of relaxation to distinguish between defects of different symmetries and thus determine the structure of the defect, was made to include the kinetics of relaxation. The internal friction apparatus and the silicon specimen preparation for the measurement of the change in internal friction with temperature due to the configuration of the point defects changing from the application of stress are described. NSA

N66-20327# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.

QUARTERLY METALLURGY PROGRESS REPORT NO. 27, APRIL 1–JULY 31, 1965

A. H. Roberson et al [1965] 33 p refs

(Contract AT(11-1)-599)

(USBM-RC-1199) CFSTI: HC $2.00/MF $0.50

Progress is reported on research on HfC, Th–ThO_2 dispersions, cold-mold induction melting equipment and techniques, UC–UN–UO system, and fabrication of W–25 Re alloy. NSA

N66-20333# California Univ., Livermore. Lawrence Radiation Lab.

POROUS METAL ISOLATION TRAPS AND CRYOSORBENTS IN VACUUM TECHNIQUE

N. Milleron 17 Aug. 1965 14 p refs Submitted for Publication

(Contract W-7405-ENG-48)

(UCRL-12393-T) CFSTI: HC $1.00/MF $0.50

Applications of two general forms of porous metals are discussed: applications of forms pierced through by optically dense pores permitting gas to flow through them, and solid core forms with surface porosity only. Among the vacuum uses of appropriate porous metals are: isolation trapping of oil during viscous and Knudsen gas flow; and cryosorbents. For example, tests show that oil contamination from up-to-air accidents when using diffusion pumps can be reduced by blocking the system flow path completely with a porous metal diaphragm filter. By corrugating a porous diaphragm filter of 150μ pore size and 1/16 in. thickness and designing optimally, system pumping speeds are increased compared to present common practice. Porous metal isolation traps for fore pumps impede pump down time <10%. Hydrogen cryosorption experiments utilizing porous copper surfaces at ≤6°K are referenced. Author (NSA)

N66-20337# Sandia Corp., Albuquerque, N. Mex.

THERMAL PROPERTIES OF SELECTED METALS AT AMBIENT TEMPERATURE

J. G. Pousma May 1965 3 p refs

(Contract AT(29-1)-789)

(SC-TM-65-242) CFSTI: HC $1.00/MF $0.50

A table of thermal and mechanical properties of some familiar metals was generated to serve as a design help where thermal characteristics of the material are important. Author (NSA)

N66-20345# Nuclear Metals, Inc., Concord, Mass.
FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY Monthly Progress Report, Feb. 1965
8 Apr. 1965 33 p refs
(Contract AT(30-1)-2784)
(NMI-2137; NYO-2784-8) CFSTI: HC $2.00/MF $0.50

Progress on development of extrusion and drawing steps for W–25 wt% Re tubing is reported. At the present stage of development, the drawing step in extrusion of 1/4-in. OD×20-mil-wall tubing requires major attention, and conditions of satisfactory re-extrusion for 80-mil×8-mil-wall tubing are being sought. Research on single-crystal deformation in zone-refined Be is reported. The effects of Th additions are being investigated, and preparation of crystals with Fe+Si+Al additions is reported. NSA

N66-20367# Cornell Univ., Ithaca, N. Y. Materials Science Center.
CREEP BY GRAIN BOUNDARY DIFFUSION
A. L. Ruoff 7 Jan. 1965 7 p refs *Its* Rept.-298
(Contract AT(30-1)-2179)
(NYO-2504-3) CFSTI: HC $1.00/MF $0.50

An equation for creep deformation where grain boundary diffusion is rate-controlling is derived: strain rate $=\dot{\epsilon}=4D_B\delta\Omega\sigma_0/R^3kT$, where D_B = diffusion coefficient of grain boundary defects, δ = thickness of layer in which diffusion occurs, Ω = atomic volume, σ_0 = tensile stress, R = crystal radius, k = Boltzmann's constant, and T = absolute temperature. The conditions under which boundary and lattice diffusion contributions are equal, are discussed. The problem of measuring D_B is considered, particularly for ionic crystals. The use of the grain size dependence of the creep rate to determine the mechanism is pointed out. NSA

N66-20391# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
STUDIES OF THE THORIUM–URANIUM DICARBIDE PSEUDOBINARY SYSTEM IN THE PRESENCE OF EXCESS GRAPHITE
Jackie Lee Cook (M.S. Thesis–Tenn. Univ., Knoxville) Sep. 1965 200 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1188) CFSTI: HC $6.00/MF $1.25

This study combined dilatometry, X-ray diffraction, metallography, thermal analysis, and chemical analysis to provide a better understanding of the phase relationships for the UC_2–ThC_2 pseudobinary system. Thermal expansion as a function of temperature up to 1000°C was determined for UC_2, ThC_2, and the $(U,Th)C_2$ alloys using drop-cast and machined specimens. The microstructural features of all as-cast alloys were similar and all contained excess graphite. Only the anneals above 1500°C for extended periods of time caused significant changes in the microstructure of the carbide or the morphology of the graphite. Microhardness tended to increase slowly with annealing time at 1900°C but did not change significantly for lower temperature anneals. Powder X-ray diffraction patterns were generally diffuse and did not improve appreciably with annealing for material that contained much excess graphite. Specimens of ThC_2 that contained only a trace of free graphite gave sharp diffraction patterns after annealing at 1400°C and below. X-ray diffraction revealed that two distinctly different body-centered tetragonal structures coexisted for alloys in the composition range from 35 to 42 mole percent ThC_2. Dilatometry and thermal analysis clearly showed two phase transformations in ThC_2 [1500 ±25° C and 1430±10° C], and the results indicated that the higher temperature transformation was diffusionless. Two similar transformations were observed for ThC_2-rich alloys containing up to 25 mole percent UC_2. One phase transformation was observed for UC_2 at 1768 ±25°C. One solid-state transformation occurred for the $(U,Th)C_2$ alloys in the composition range from 25 to 75 mole percent ThC_2. The transformation temperatures in this composition range passed through a minimum (approximately 1100°C) at approximately 46 mole percent ThC_2. Two phase diagrams, either of which is consistent with experimental observations, were proposed for the UC_2–ThC_2 pseudobinary system. The mean coefficients of expansion for the $(U,Th)C_2$ alloys between room temperature and 1000° C varies from $8.6\times10^{-6}°C^{-1}$ for ThC_2 to $13.5\times10^{-6}°C^{-1}$ for UC_2. Author (NSA)

N66-20394# Nuclear Metals, Inc., Concord, Mass.
TECHNICAL PAPERS OF THE SEVENTEENTH METALLOGRAPHIC GROUP MEETING, HELD MAY 21–23, 1963 AT LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, NEW MEXICO
H. Roth Roman, comp. 1 Apr. 1965 166 p refs
(Contract AT(30-1)-1565)
(NMI-4999; CONF-105) CFSTI: HC $5.00/MF $1.00

Sixteen papers are included; separate abstracts have been prepared for 9. NSA

N66-20402# National Lead Co. of Ohio, Cincinnati.
METALLOGRAPHY—CONCERNING THE EXISTENCE OF AN ALLOTROPIC CHANGE TO CUBIC U_3Si WITHIN THE URANIUM–SILICON SYSTEM
Pierre L. Blum, Georges Silvestre, and Henri Vangoyeau 30 Aug. 1965 5 p Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 260, no. 21, 24 May 1965 p 5538–5541
(NLCO-TR-6)

Studies at high temperatures by differential thermal analysis, dilatometry, and X-ray diffraction of uranium alloys with a silicon content giving the compound δ U_3Si revealed the existence of a tetragonal→cubic transition at 765°C ±3°C. The new phase, δ, is isostructural with Cu_3Au I and its range of stability extends to 930°C, the temperature of the peritectoid decomposition of U_3Si. Author (NSA)

N66-20408# Societe d'Etudes, de Recherches et d'Application pour l'Industrie, Brussels (Belgium).
CORROSION STUDIES ON STEELS IN WATER AND STEAM AT HIGH TEMPERATURE Quarterly Progress Report No. 10, 1 Oct.–31 Dec. 1964
29 Jan. 1965 82 p refs Transl. into ENGLISH from French
(EURATOM-089-62-7 RDB)
(EURAEC-1308) CFSTI: HC $3.00/MF $0.75

The static corrosion tests in superheated steam were continued for stainless steel type AISI 304, for the purpose of finding the type of oxidation obtained after sanding the surface of the test pieces. Silica sanding by compressed air has the same behavior as all the cold-worked states studied up to the present. In addition, the first tests in steam at 500°C, with the addition of oxygen, have been carried out. Subject to confirmation, the addition of a quantity of oxygen ≤80 ppm does not appear to greatly modify the behavior in superheated steam and, in particular, the advantage gained by surface work-hardening. Finally, it will be noted that a very light electrolytic polishing of milled test pieces (1 to 1.5 μ solution), does not change their behavior in superheated steam at 500°C whilst there is an extremely harmful effect in respect to corrosion in water at 300°C. Detailed

metallographic examinations effected on different samples of 18-10 steel treated mechanically and then oxidized in steam at 500°C show that the presence of oxide precipitates in the metallic cold-worked area, under the continuous layer of oxides, is very probable. The dynamic corrosion tests in water at 300°C, 150 kg/cm^2, and 10 m/sec, effected for varying periods up to 2,000 hours, have been completed. These tests show that the corrosion rate of 18-10 steel becomes very low above 1,000 hr of testing. Tests of extremely long duration would be necessary to define its value more accurately, which is between 0 and 5 mg/dm^2/month. It is confirmed that the "surface state" factor has no appreciable influence on the rate of 10 m/sec. For boiler steel, it is verified that the "metal in water" component constitutes the principal corrosion element, which progresses linearly at a rate of approximately 500 mg/dm^2/month. The adherent oxide skin on the test pieces is invariably 1 μ, whatever the duration of the test. The classification of the surface states remains that obtained during earlier static tests, the differences being greatly reduced, however. It is probable that the residual differences observed at the rate of 10 m/sec, are only apparent and attributable to the incidence of the surface treatment on the true surface of the test pieces. Author

N66-20412# California Univ., Berkeley. Lawrence Radiation Lab.
CLIMB OF IMPERFECT DISLOCATIONS IN ALUMINUM
Nathapet Durai Raghavan (M.S. Thesis) Jan. 1965 34 p refs
(Contract W-7405-ENG-48)
(UCRL-11897) CFSTI: HC $2.00/MF $0.50

Climb of imperfect dislocations in aluminum of 99.999% purity was by transmission electron microscopy. Annealing at different temperatures of the electron microscope specimens was carried out in a furnace, the specimen being periodically returned to the electron microscope for observation of selected dislocation loops. Friedel's theory of dislocation climb has been applied to the climb of imperfect loops to explain the observed rates of decrease in loop diameter with annealing time at various temperatures. The experiments give 130 ergs/cm^2 as the stacking fault energy of aluminum. Author

N66-20428# Battelle Memorial Inst., Geneva (Switzerland).
THE EFFECT OF RADIATION ON THE DUCTILE-BRITTLE TRANSITION IN PRESSURE VESSEL STEELS Sixteenth Quarterly Report, Oct. 1, 1964–Jan. 31, 1965
E. Anderson, D. G. Brandon, G. T. Hahn, D. L. King, D. Langheinrich et al Feb. 1965 35 p refs
(Contract EURATOM 095-62-12 RDS)
(EURAEC-1343) CFSTI: HC $2.00/MF $0.50

Dislocation arrangements in Armco iron were revealed by etch-pitting with Fry's reagent. Two groups of specimens—one group annealed above the transformation range, and the other below it—were examined before and after deformation at room temperature and at −196°C. Details of the initial substructure, the identity of active sources, the character of slip at the two temperatures, and some features of the twinning process at −196°C are described. Preliminary experiments on the field-ion microscopy of steels are reported. Neon images of pure iron, Armco iron and a Fe-1.6 wt % Si alloy were produced and recorded successfully. Author (NSA)

N66-20455# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
PROPERTIES OF SOME REFRACTORY METALS. III: THERMAL EXPANSION CHARACTERISTICS OF TUNGSTEN, RHENIUM, TANTALUM, MOLYBDENUM, NIOBIUM, W-25Re, Ta-10W, AND Mo-50Re
J. B. Conway 29 Jun. 1965 33 p refs
(Contract AT(40-1)-2847)
(GEMP-375) CFSTI: HC $2.00/MF $0.50

Previously published linear thermal expansion data for several refractory metals and refractory metal alloys are reviewed and compared. In addition, an optical technique is described which was employed to measure the expansion characteristics of several refractory metals and alloys to 2500°C. These most recent data are also compared to the existing data. A refraction error has been identified which is inherent in the optical measurement of thermal expansion for certain experimental conditions. Tests in helium have been shown to yield results that are noticeably lower than those obtained in vacuum. Correction factors have been obtained for use with the helium tests to obtain accurate expansion values. Linear thermal expansion data to 2500°C are reported for W, Re, Ta, Mo, Nb, W-25 Re, Ta-10 W, and Mo-50 Re. Author (NSA)

N66-20457# Denver Research Inst., Colo.
PHASE EQUILIBRIA OF THE TANTALUM-RICH REGION OF THE TANTALUM-TUNGSTEN-HAFNIUM AND TANTALUM-TUNGSTEN-ZIRCONIUM SYSTEMS Quarterly Progress Report No. 3, 1 Mar.–31 May 1965
Donald T. Klodt and Albert S. Yamamoto Jun. 1965 7 p
(Contract AT(11-1)-1092)
(DRI-1092-212) CFSTI: HC $1.00/MF $0.50

Data are presented on the progress of the long-term, high temperature vacuum annealing treatments and the metallographic examination of the isothermally annealed alloys in the Hf–Ta–W and Ta–W–Zr systems. NSA

N66-20475# MSA Research Corp., Callery, Pa.
EFFECT OF HIGH-TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS Progress Report No. 54
16 Mar. 1965 26 p ref
(Contract AT(11-1)-765)
(MSAR-65-38) CFSTI: HC $2.00/MF $0.50

A summary is presented of the status of work on the effects of high-temperature sodium and contaminants on the mechanical properties of Type 316 stainless steel and 2-1/4 Cr–1 Mo steel. Results to date for Tests 3 and 5 (Type 316 stainless steel in high-carbon and high-oxygen sodium at 1200°F) indicate that the contaminants increase the creep-to-rupture life and reduce the ductility. Results of sodium sample analyses for impurities are tabulated. The development of extensometers for measuring creep rates in sodium is discussed briefly. NSA

N66-20476# MSA Research Corp., Callery, Pa.
EFFECT OF HIGH-TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS Progress Report No. 53, Jan. 1965
24 Feb. 1965 42 p refs
(Contract AT(11-1)-765)
(MSAR-65-28) CFSTI: HC $2.00/MF $0.75

The status of work in the research program is summarized. The progress of Test 3 (Type 316 stainless steel in 1200°F high-carbon sodium) is reported; the results to date indicate that carbon contamination in sodium reduces the

fatigue life, impact strength, and ductility while increasing the creep-rupture life. Similarly, an increase in creep-rupture strength and a decrease in ductility and minimum creep rate were observed in Test 5 (Type 316 stainless steel in 1200°F high-oxygen sodium). Metallographic analysis and chemical analysis of sodium are reported. Special fatigue runs on Type 304 stainless steel indicate a shorter fatigue life in 1200°F high-oxygen sodium than in 1200°F air.

Author (NSA)

N66-20489# California Univ., Berkeley. Lawrence Radiatior Lab.

DISLOCATION ARRANGEMENTS IN DEFORMED COPPER POLYCRYSTALS

Gopinathan Vellaikal (M.S. Thesis) Jan. 1963 25 p refs
(Contract W-7405-ENG-48)
(UCRL-11858) CFSTI: HC $1.00/MF $0.50

The very early stages of plastic deformation were studied by means of etch pit techniques in large grained copper polycrystals deformed in compression. Special attention was given to regions near grain boundaries in an attempt to clarify the role of grain boundaries in plastic deformation. Their role as barriers to slip during the early stages of plastic deformation was clearly demonstrated. One of the first indications that plastic deformation had taken place was the operation of Frank Read sources. The resulting dislocation loops frequently traversed the entire cross section of the grain and piled up against the grain boundary. Author (NSA)

N66-20498# California Univ., Berkeley. Lawrence Radiation Lab.

INTERSTITIAL ORDERING OF CARBON IN TANTALUM

Robert Emerick Villagrana (M.S. Thesis) Jan. 1965 44 p refs
(Contract W-7405-ENG-48)
(UCRL-11782) CFSTI: HC $1.00/MF $0.50

The effect of interstitial carbon in tantalum was investigated by transmission electron microscopy and selected area diffraction. Interstitial ordering was found, and the ordered structure was determined from computation and comparison with electron diffraction data. The superlattice structure is tetragonal, with a c/a ratio of 1.128, and an ideal composition of $Ta_{64}C$. Since the superlattice was determined from thin foils, it was necessary to compare the thin foil results with bulk specimens, alloyed to correspond to $Ta_{64}C$. Microscopic examination of bulk specimens showed many domain boundaries, separating regions in which the tetragonality associated with ordering was oriented in different directions. An analysis of these domain boundaries indicates that there are three possible types: coherent, semicoherent, and antiphase. Author (NSA)

N66-20516# Iowa State Univ. of Science and Technology, Ames.

THERMAL DIFFUSIVITY OF PLATINUM

J. J. Martin, P. H. Sidles, and G. C. Danielson 14 Oct. 1965 11 p refs Presented at the 5th Conf. on Thermal Conductivity, Denver
(Contract W-7405-ENG-82)
(IS-1261; CONF-651020-2) CFSTI: HC $1.00/MF $0.50

The thermal diffusivity of four platinum samples with resistivity ratios of 34, 100, 900, and 5000 was measured from 300° to 1200°K. The thermal diffusivity was not sensitive to small amounts of impurities. Thermal conductivity values were calculated from these results and compared with the thermal conductivity results of other investigators. At room temperature most results are in good agreement, but at high temperatures the agreement among different investigators is unsatisfactory. The data from these four specimens indicate that platinum would be suitable for a thermal conductivity standard, but additional measurements should be made by other absolute methods. Author (NSA)

N66-20517# Iowa State Univ. of Science and Technology, Ames.

THERMAL DIFFUSIVITY OF ARMCO IRON BY THREE METHODS

A. H. Klein, H. R. Shanks, and G. C. Danielson 14 Oct. 1965 8 p refs Presented at 5th Thermal Conductivity Conf., Denver
(Contract W-7405-ENG-82)
(IS-1266; CONF-651020-3) CFSTI: HC $1.00/MF $0.50

The thermal diffusivity of Armco iron was measured by three different methods in the temperature range 25 to 1100°C. The methods were the finite rod method, the radial method, and the modified Angstrom method. The data obtained by the three methods are in good agreement. The results were used to calculate thermal conductivity values which were compared with the results of others.

Author (NSA)

N66-20531# California Univ., Livermore. Lawrence Radiation Lab.

FIRE-RETARDANT COATINGS

James R. Gaskill 19 May 1964 22 p refs Preprint
(Contract W-7405-ENG-48)
(UCRL-7860) CFSTI: HC $1.00/MF $0.50

Some of the observations from the 1959 field season on the density and seasonal movements of nonbreeding birds and on winter birds in the Cape Thompson region are given. Field work on marine mammals are described, and the present state of information on these mammals is summarized.

Author (NSA)

N66-20572# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TREATMENT OF HIGH STRENGTH STEELS WITH THE USE OF ELECTRICAL HEATING

Yu. G. Andreyev, Ye. K. Zakharov et al 4 Jan. 1966 12 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chern. Met. (Moscow), no. 3, 1965 p 157–160
(FTD-TT-65-1472/1+2+4; AD-627121) CFSTI: HC $1.00/MF $0.50

The structure and properties of low-alloyed steel were investigated after hardening by electrical heating. A 50-cycle current was passed through the specimens to produce a heating rate of 75°C/sec. Cooling from 1200° to 250°C was done at a rate of 50°–80°C/sec. The results obtained were compared with the properties of steel after the usual hardening process. Bending and fracture under load, hardness, electrical resistance, and residual austenite were determined for the specimens. Graphs are given showing the change in properties with the temperature of the hardening and tempering processes. Steels containing relatively high amounts of molybdenum and vanadium were also tested, and it was found that electrical hardening lowered the limit of strength after optimum tempering. However, the low-alloyed steels could be subjected to induction hardening without loss of the mechanical properties. E.A.O.

N66-20574# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

MECHANICAL BEHAVIOR OF COMPOSITE MATERIALS Summary Report

James W. Mar and Lawrence A. Shepard 1 Sep. 1965 14 p refs *Its* Progress Rept.-94-6
(Contract AF 49(638)-775)
(DSR-8434; AFOSR-65-1936; AD-627173) CFSTI: HC $1.00/MF $0.50

A study was conducted to develop an understanding of the interaction of stronger and more ductile phases in determining the mechanical behavior and fracture of metallic composites. It was directed to composites in which the strong phase constituted the major volume fracture. The following aspects were particularly emphasized: (1) the relationship of the properties of individual phases to their behavior in a composite; (2) the effect of the shape, size and volume fraction, distribution, and spacing of the phases upon the properties; and (3) the thermodynamic properties, i.e., phase relationships solubilities, and interfacial tensions of the composites. TAB

N66-20592# Franklin Inst., Philadelphia, Pa. Research Labs.
EVALUATION OF FRICTION AND WEAR CHARACTERISTICS OF MATERIALS FOR GAS-LUBRICATED BEARINGS UNDER CONDITIONS OF START-STOP, AND WHIRL INDUCED RUBBING Final Technical Report
J. G. Hinkle and D. D. Fuller Sep. 1965 94 p refs
(Contract Nonr-4569(00))
(F-B2232; AD-625376) CFSTI: HC $3.00/MF $0.75

A materials evaluation study was made as applied to 'general' types of self-acting gas-lubricated bearings under start-stop cycling with equal emphasis on ability to sustain whirl-induced solid contact. The study entailed a systematic program of investigation and classification of the performance in a realistic bearing environment of likely combinations of materials, surface treatments, and coatings at four ambient conditions: air at room temperature and atmospheric pressure, air at 300°F and atmospheric pressure, nitrogen at 300°F and atmospheric pressure. Concurrent with the above mentioned tasks, 'bearing' instability characteristics (in contrast to journal instability) were studied experimentally and correlated with theory. Author (TAB)

N66-20595# Carnegie Inst. of Tech., Pittsburgh, Pa. Metals Research Lab.
OPTICAL PROPERTIES OF METALS AND ALLOYS Final Report
L. E. Murr and W. R. Bitler (Pa. State Univ.) 4 Aug. 1965 56 p refs Work done in part at Pa. State Univ.
(Contract AF 49(638)-478)
(AFOSR-65-1843; AD-625371) CFSTI: HC $3.00/MF $0.50

The object of this investigation was to determine the optical absorption coefficients of copper, nickel, and a series of copper–nickel alloys. Technical difficulties were encountered in analyzing the samples of thickness and composition by the X-ray fluorescence method. These difficulties were resolved by the following changes in procedure: flash evaporation permitting the evaporation of previously prepared alloys of known composition, epitaxial deposition on halide substrates, and subsequent examination by electron diffraction and transmission microscopy. Three separate papers giving detailed descriptions of the work are attached.
Author (TAB)

N66-20632# Joint Publications Research Service, Washington, D. C.
STUDIES IN THE TREATMENT AND PROPERTIES OF TITANIUM ALLOYS
9 Mar. 1966 39 p refs Transl. into ENGLISH from Russian periodicals
(JPRS-34481; TT-66-30921) CFSTI: $2.00

CONTENTS:

1. HOT MECHANICAL WORKING OF VT14 ALLOY FORGINGS I. N. Kaganovich, Yu. I. Potapenko, and Ye. D. Igumenshchev p 1–9 ref (See N66-20633 10-17)

2. INFLUENCE OF HEAT TREATMENT AND CLADDING ON STRENGTH OF VT14, VT15, AND VT16 Ti ALLOYS IN TWO-WAY TENSION A. I. Chorev, S. G. Glazunov, T. K. Zilova, N. I. Novosil'tseva, and L. V. Geras'kova p 10–17 ref (See N66-20634 10-17)

3. INFLUENCE OF HYDROGEN ON THE STRUCTURE AND PROPERTIES OF VT15 ALLOY B. A. Kolachev, V. A. Livanov, A. A. Bukhanova, and N. Ya. Gusel'nikov p 18–25 refs (See N66-20635 10-17)

4. APPLICATION OF NITRIDED VT14 ALLOY FOR GEARS Ye. N. Novikova, S. I. Gurevich, and L. M. Nikitina p 26–33 ref (See N66-20636 10-17)

N66-20633 Joint Publications Research Service, Washington, D. C.
HOT MECHANICAL WORKING OF VT14 ALLOY FORGINGS
I. N. Kaganovich, Yu. I. Potapenko, and Ye. D. Igumenshchev *In its* Studies in the Treat. and Properties of Titanium Alloys 9 Mar. 1966 p 1–9 ref Transl. into ENGLISH from Tsvetnyye Metally (Moscow), no. 10, Oct. 1965 p 75–79 (See N66-20632 10-17) CFSTI: $2.00

Reported are studies on the possibility of producing stable properties in VT14 alloy products which were batch produced by hot mechanical working. The test conditions and processes are described and the effectiveness of applying the established hot mechanical working conditions to commercial scale products was assessed. It was concluded that: the ductility of VT14 alloys was enhanced by the application of hot mechanical working during hot pressing and, the augmented ductility of the VT14 alloy is the result of the large dispersity of the structural components as well as a more uniform distribution of them, throughout the entire metal, during straining in tension. In drawing these conclusions, it was reported that the reduced hardenability of the VT14 alloy has to be taken into consideration when evaluating the feasibility of employing hot metal working. H.S.W.

N66-20634 Joint Publications Research Service, Washington, D. C.
INFLUENCE OF HEAT TREATMENT AND CLADDING ON STRENGTH OF VT14, VT15, AND VT16 Ti ALLOYS IN TWO-WAY TENSION
A. I. Chorev, S. G. Glazunov, T. K. Zilova, N. I. Novosil'tseva, and L. V. Geras'kova *In its* Studies in the Treat. and Properties of Titanium Alloys 9 Mar. 1966 p 10–17 ref Transl. into ENGLISH from Tsvetnyye Metally (Moscow), no. 9, Sep. 1965 p 75–79 (See N66-20632 10-17) CFSTI: $2.00

Presented are the results of two-way tension tests of VT14, VT15 and VT16 alloy test specimens. The specimens were spherically shaped and were subjected to various heat treatments. The influence of cladding on toughness was also examined. The preparation of the test specimens was described and the procedures used in conducting the analysis were explained. The following conclusions were reported: (1) The toughness of Ti alloy test specimens under symmetric two-way tension is higher than the toughness under axial tension. (2) Cladding of high strength VT14, VT15, and VT16 alloys with commercially pure VT1 titanium, permits an increase in toughness to be attained under two-way tension and also improved the nature of the fracture in the test specimens. H.S.W.

N66-20635 Joint Publications Research Service, Washington, D. C.
INFLUENCE OF HYDROGEN ON THE STRUCTURE AND PROPERTIES OF VT15 ALLOY

B. A. Kolachev, V. A. Livanov, A. A. Bukhanova, and N. Ya. Gusel'nikov *In its* Studies in the Treat. and Properties of Titanium Alloys 9 Mar. 1966 p 18–25 refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Tsvet. Met. (Dzaudzhikau), no. 3, 1965 p 131–135 (See N66-20632 10-17) CFSTI: $2.00

The influence of hydrogen on the structure and properties of beta Ti alloys in quenched and age-hardened condition was studied. The VT15 alloy tested included 3.7% Al, 7.35% Mo, 10.6% Cr, 0.11% Fe, 0.04% Si, 0.03% C and 0.12% O_2. Test results indicated that hydrogen at concentrations up to 0.2% does not evoke hydrogen embrittlement in the quenched VT15 alloy. These results were obtained at room temperature with normal and slow rates of travel of the tensile testing machine's crosshead. Additionally, since hydrogen is a beta stabilizer, it was found to increase the stability of the beta phase and reduce the rate of its decomposition and the quantity of the precipitating hardening alpha phase. For this reason, hydrogen lowers the toughness of the precipitated hardened VT15 alloy with a simultaneous rise in ductility. H.S.W.

N66-20636 Joint Publications Research Service, Washington, D. C.

APPLICATION OF NITRIDED VT14 ALLOY FOR GEARS

Ye. N. Novikova, S. I. Gurevich, and L. M. Nikitina *In its* Studies in the Treat. and Properties of Titanium Alloys 9 Mar. 1966 p 26–33 refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), No. 10, Oct. 1965 p 19–22 (See N66-20632 10-17) CFSTI: $2.00

The feasibility of using a nitrogen hardened VT14 alloy in the manufacture of gears was studied. The results of investigating the wear resistance of fine pitch gears made from this alloy are discussed. The design and basic dimensions of the experimental conjugate cylindrical straight tooth gears are shown. The nitrogen hardening procedure and the experimental processes are described. The tests indicated that the VT14 alloy gears which were nitrogen hardened are serviceable and capable of prolonged service. The coefficient of their relative wear was found to be $\epsilon = 1.3–1.8$. These same gears which were nitrogen hardened with subsequent aging, were reported to have the highest resistance of 10^6 stress cycles. From these data it was concluded that the use of the VT14 alloy as a nitrogen hardened constructional material for the production of gears is feasible. H.S.W.

N66-20702# Joint Publications Research Service, Washington, D. C.

RHENIUM ALLOYS

Ye. M. Savitskiy, M. A. Tylkina, and K. B. Povarova 15 Mar. 1966 234 p refs Transl. into ENGLISH of selected articles from the book "Splavy Reniya" Moscow, "Nauka" Publ. House, 1965

(JPRS-34566; TT-66-31006) CFSTI: $6.00

The production, preparation, properties, and uses of rhenium and rhenium alloys are discussed. Corrosion resistance, heat expansion, weldability, and mechanical, elastic, and catalytic properties are described. The uses in electronics, electric contacts, thermocouples, and electrical engineering are reviewed. Bibliographies are included at the end of the chapters. N.E.N.

N66-20716# Naval Research Lab., Washington, D. C. Metallurgy Div.

IN-REACTOR STUDIES OF LOW CYCLE FATIGUE PROPERTIES OF A NUCLEAR PRESSURE VESSEL STEEL Final Report

L. E. Steele and J. R. Hawthorne 27 Jul. 1964 20 p refs (NRL-6127; AD-606773) CFSTI: HC $2.00/MF $0.50

An experimental irradiation assembly and associated instrumentation which have been developed and successfully utilized for the performance of dynamic in-reactor low cycle fatigue tests of reactor pressure vessel steels are described. The equipment provides for the simultaneous reverse bend testing of as many as fifteen sheet type specimens representing a range of strain amplitudes at controlled temperatures in the range 300° to 700°F. The results of an exploratory investigation on the fatigue resistance of ASTM type A302-B steel during irradiation at 500°F are presented and compared with data from out-of-reactor control tests. These preliminary data do not indicate any pronounced difference in the fatigue strength of irradiated versus unirradiated steel. Exploratory investigations are continuing.

Author (TAB)

N66-20774 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.

RARE EARTH TUNGSTEN BRONZES

Werner Ostertag *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 4: Solid State Session p 2 [1965] p 67-78 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75

Rare earth tungsten bronzes of the general formula Me_xWO_3 have been prepared, where Me is Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Er, Tm and Lu. The bronzes exhibit perovskite-type structures and have broad homogeneity ranges. The cubic high temperature phase of the rare earth tungsten bronzes was stabilized by cooling the bronzes rapidly from 1100° C to room temperature. The x- value of the cubic europium bronze was found to range from $x=0.08$ to $x=0.16$. Magnetic susceptibility measurements were carried out. The magnetic data give evidence that all bronzes contain trivalent rare earth ions. The result of the magnetic measurements is discussed for the representative samples $Ce_{0.1}WO_3$, $Eu_{0.1}WO_3$ and $Gd_{0.1}WO_3$ on the basis of the electron gas model. Author

N66-20779# Iowa State Univ. of Science and Technology, Ames.

FIFTH RARE EARTH RESEARCH CONFERENCE, AUGUST 30, 31, SEPTEMBER 1, 1965. BOOK FIVE: METALLURGY SESSION M

Washington, AFOSR [1965] 127 p refs

(Contract AF-AFOSR-812-65)

(AFOSR-65-1917, Bk.-5; AD-627225) CFSTI: HC $4.00/MF $1.00

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2. SOLID SOLUBILITY OF SOME GOLD-RICH-RARE-EARTH AND LANTHANIDE-RICH MAGNESIUM ALLOYS P. E. Rider, R. R. Joseph, O. D. McMasters, and K. A. Gschneidner, Jr. p 13–22 refs (See N66-20781 10-17)

3. SYSTEMATIC ARRANGEMENT OF THE BINARY RARE-EARTH ALUMINIUM SYSTEMS K. H. J. Buschow and J. H. N. van Vucht (Philips Gloeilampenfabrieken N. V.)

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4. CRYSTAL STRUCTURES OF COMPOUNDS OF THE RARE EARTHS WITH Cu, Ag, Au, AND Ga A. E. Dwight, R. A. Conner, Jr., and J. W. Downey (Argonne Natl. Lab.) p 35–44 refs (See N66-20783 10-17)

5. THE CRYSTAL STRUCTURES OF $CeFe_7$, $PrFe_7$, $NdFe_7$, AND $SmFe_7$ A. E. Ray (Dayton Univ.) p 45–56 refs (See N66-20784 10-17)

6. THE CRYSTAL CHEMISTRY OF THE INTERMEDIATE PHASES IN THE YTTERBIUM-ANTIMONY SYSTEM R. E. Bodnar and H. Steinfink (Texas Univ.) p 57–66 refs (See N66-20785 10-06)

7. THE YTTRIUM-COBALT ALLOY SYSTEM K. J. Strnat, W. Ostertag, N. J. Adams, and J. C. Olson (AFSC, Wright-Patterson AFB) p 67–76 refs (See N66-20786 10-17)

8. PREPARATION OF RE-Mn ALLOYS BY THE "AMALGAM PROCESS" X-RAY-, DIFFERENTIAL THERMAL AND THERMOMAGNETIC ANALYSES H. R. Kirchmayr (Tech. Hochschule, Vienna) p 77–88 refs (See N66-20787 10-17)

9. SOLID-STATE ELECTROLYSIS OF GADOLINIUM C. D. Graham, Jr. (GE) p 89–99 refs (See N66-20788 10-06)

10. ELECTROTRANSPORT OF INTERSTITIAL ATOMS IN YTTRIUM O. N. Carlson, F. A. Schmidt, and D. T. Peterson p 101–118 refs (See N66-20789 10-06)

11. THE LIQUID DENSITIES OF CERIUM AND NEODYMIUM METALS W. G. Rohr (Mound Lab.) p 119–127 refs (See N66-20790 10-23)

N66-20781 Iowa State Univ. of Science and Technology, Ames.

SOLID SOLUBILITY OF SOME GOLD-RICH-RARE-EARTH AND LANTHANIDE-RICH MAGNESIUM ALLOYS

P. E. Rider, R. R. Joseph, O. D. Mc Masters, and K. A. Gschneidner, Jr. *In its* Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 5: Met. Session M [1965] p 13–22 refs (See N66-20779 10-17) CFSTI: HC $4.00/MF $1.00

The solid solubilities of the rare-earth metals in gold and of magnesium in the lanthanide metals have been studied and the observed behaviors have been correlated with the Hume-Rothery and Darken-Gurry rules governing solid solution formation. The experimental data can be correlated with these rules provided we take into account the modification of the sizes and electronegativities of the solutes as they are placed into the solvent matrix, and for the magnesium alloys if we compare the data at some convenient homologous temperature. Author

N66-20782 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Philips Research Labs.

SYSTEMATIC ARRANGEMENT OF THE BINARY RARE-EARTH ALUMINIUM SYSTEMS

K. H. J. Buschow and J. H. N. van Vucht *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 5: Met. Session m [1965] p 23-33 refs (See N66-20779 10-17) CFSTI: HC $4.00/MF $1.00

A number of binary rare-earth aluminium systems were investigated by X-ray diffraction and thermoanalytical methods. It is shown that both the stability and composition of the intermetallic compounds found in these systems are strongly influenced by the atomic size of the rare-earth metals R. If these binary systems are arranged in order of decreasing radius it appears that a compound R_3Al exists only for rare-earth metals with relatively large radius. With decreasing radius, a compound R_2Al is also observed. It becomes gradually more stable, while R_3Al disappears. For still smaller radii a compound R_3Al_2 is found in addition to R_2Al. The compounds RAl and RAl_2 exist for all rare-earth metals investigated. Here, however, some interesting relationships exist between the decreasing radius and the crystal structures of the compounds. Between RAl_2 and aluminium the compounds RAl_3 and RAl_4 are found. RAl_3 is relatively more stable for small radii and RAl_4 for large radii. Author

N66-20783 Argonne National Lab., Ill.

CRYSTAL STRUCTURES OF COMPOUNDS OF THE RARE EARTHS WITH Cu, Ag, Au AND Ga

A. E. Dwight, R. A. Conner, Jr., and J. W. Downey *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965 Bk. 5: Met. Session M [1965] p 35–44 refs (See N66-20779 10-17) CFSTI: HC $4.00/MF $1.00

Equiatomic compounds were prepared, in which the A element is a rare earth metal and the B element is Cu, Ag, Au or Ga. The alloys were made by arc-melting and were water-quenched after annealing at an elevated temperature. Crystal structures and lattice parameters were determined by X-ray powder diffraction methods. The CsCl and FeB structure types were found in the compounds of a rare earth metal with Cu, Ag or Au. The CrB structure type was found in the compounds of a rare earth metal with Ga. No experimental work was done on Eu and Yb alloys. There is a systematic variation of lattice parameters with the atomic volume. Author

N66-20784 Dayton Univ., Ohio. Research Inst.

THE CRYSTAL STRUCTURES OF $CeFe_7$, $PrFe_7$, $NdFe_7$, AND $SmFe_7$

Alden E. Ray *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965 Bk. 5: Met. Session M [1965] p 45–56 refs (See N66-20779 10-17) CFSTI: HC $4.00/MF $1.00

The isostructural phases $CeFe_7$, $PrFe_7$, $NdFe_7$, and $SmFe_7$ are rhombohedral, the probable space group is $R\bar{3}m$. The hexagonal unit cells contain seven rare earth and forty-nine iron atoms. The atomic arrangements are intermediate between those of the $D2_d$-$CaCu_5$ and Th_2Zn_{17} structural types. One rare earth and four iron atoms statistically occupy a set of positions which are occupied by three A atoms in AB_5 structures and by six B atoms in A_2B_{17} structures. The lattice constants for the triply primitive hexagonal unit cells are tabulated. Author

N66-20786 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.

THE YTTRIUM-COBALT ALLOY SYSTEM

K. J. Strnat, W. Ostertag, N. J. Adams, and J. C. Olson *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 5: Met. Session M [1965] p 67–76 refs (See N66-20779 10-17) CFSTI: HC $4.00/MF $1.00

The yttrium–cobalt system has been investigated by thermal analysis, X-ray diffraction and metallography. There are eight intermetallic compounds present corresponding to the ideal compositions Y_3Co, Y_3Co_2, Y_2Co_3, YCo_2, YCo_3, Y_2Co_7, YCo_5 and Y_2Co_{17}. Of these, Y_2Co_{17} appears to melt congruently, the others decompose peritectically. There is a eutectic between Y_3Co and Y_3Co_2 at approximately 37 atomic % Co which melts at 715°C. A second eutectic with a melting point of 1330°C occurs between

Y_2Co_{17} and cobalt, near 92 atomic % Co. A phase diagram is proposed and the experimental evidence discussed in some detail. Crystallographic data, based on powder diffraction patterns, are presented for most of the intermediate phases. Author

N66-20787 Technische Hochschule in Wien (Austria). Institut für Angewandte Physik.
PREPARATION OF RE-Mn-ALLOYS BY THE "AMALGAM PROCESS" X-RAY-, DIFFERENTIAL THERMAL AND THERMOMAGNETIC ANALYSES
Hans R. Kirchmayr *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 5: Met. Session M [1965] p 77-88 refs (See N66-20779 10-17)
CFSTI: HC $4.00/MF $1.00
(Contract AF 61(052)-609)

A special method for preparation of RE-alloys, the modified amalgam process, is described and its application to RE-Mn alloys discussed. It consists of the preparation of RE-Mn-Hg alloys which after heating yield Hg-free RE-Mn alloys at temperatures below the liquidus state. The alloys are powdery or slightly sintered and can be of single phase. During a study of the systems (Y,Sm,Gd,Dy,Ho,Er)-Mn the phases $REMn_2$, $REMn_5$ and $REMn_{12}$ have been detected. The schematic phase diagrams of Gd-Mn, Dy-Mn and Ho-Mn have been established by DTA. The magnetic properties of the respective $REMn_5$ phases have been measured between 80° and 1400° C. These compounds are ferrimagnetic with the exception of YMn_5, which is ferromagnetic. Author

N66-20791# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
REPORT ON THE MEETING OF THE SCIENTIFIC COMMITTEE ON HEAT-RESISTANT MATERIALS ON 10 OCTOBER 1963 IN MUNICH [BERICHT UBER DIE SITZUNG DES FORSCHUNGSAUSSCHUSSES WARMFESTE WERKSTOFFE AM 10. OCTOBER 1963 IN MUNCHEN]
K. Bungardt Oct. 1965 68 p refs In GERMAN
(DLR-Mitt.-65-08) CFSTI: HC $3.00/MF $0.75

Discussed are the following topics: (1) *State-of-the-Art in Beryllium Technology and Guidelines for Beryllium Research in Germany*—brittleness, and improved ductility through high temperature modification of beryllium hexagonal structure into cubic pattern; (2) *Remelting of Two Industrial Aircraft Steels in an Electron Beam Furnace*—vaporization of alloy elements at high gas pressure, and decrease in time creep strength; (3) *Increased Ignition Stabilization of High Temperature Materials through Dispersion of Metals*—surface oxidation protection by structural diffusion of chromium layer; (4) *State-of-the-Art in the Development of Dispersion Hardened Metals and Alloys*—hardening of cobalt and cobalt alloys and of Ni-Al_2O_3, Ni-CrO_3, NiTiO_2, and NiSiO_2 alloys, through addition of various oxides and carbides.
Transl. by G.G.

N66-20802# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
DEFORMATION CHARACTERISTICS OF METALS AND ALLOYS Final Report
V. Weiss, R. Kot, and D. Oelschlagel Sep. 1965 103 p refs
(Contract NOw-65-0090-F)
(MET. E.-1241-0965-FR; AD-624267) CFSTI: HC $4.00/MF $0.75

The effects of deformation during a phase transformation were studied on the three plain carbon steels AISI 1018, 1045 and 1095, the bearing steel AISI 52100 and commercially pure titanium. Specimens subjected to a constant load were cycled through the alpha reversibly yields gamma or alpha reversibly yields beta transformation range. A considerable increase in the creep rate is observed due to the occurrence of the phase transformations. For the steels, the elongation per complete temperature cycle increases linearly with the applied stress up to 2500 psi and elongations of 500 percent and more are observed on specimens temperature cycled to complete failure. It is further shown that on heating (alpha yields gamma transformation) the steels investigated deform more than on cooling (gamma yields alpha transformation). Titanium also exhibits a linear relationship between the elongation per temperature cycle and the applied stress, and gives an elongation of approx. 300% when temperature cycled to failure. Author (TAB)

N66-20814# Naval Research Lab., Washington, D. C.
METALLURGICAL CHARACTERISTICS OF HIGH STRENGTH STRUCTURAL MATERIALS Eighth Quarterly Report, May-Jul. 1965
P. P. Puzak, K. B. Lloyd, R. J. Goode, R. W. Huber, D. G. Howe et al Aug. 1965 99 p refs
(NRL-6364; AD-625374) CFSTI: HC $3.00/MF $0.75

A progress report covering research studies in high strength structural materials conducted in the period May 1965 to July 1965 is presented. The report includes fracture toughness studies on the 12% Ni maraging and 9Ni-4Co-.XXC steels, a variety of titanium alloy MIG, EB, and plasmarc weldments, and some aluminum alloys. The current fracture toughness index diagrams are presented for steels, titanium alloys, and aluminum alloys. Results are presented of (1) a study of the planestrain fracture toughness of the alloys Ti-6Al-4V and Ti-6Al-6V-2.5Sn over respective yield strength ranges of 130-140 ksi and 147-186 ksi; (2) heat-treatment studies on several titanium alloys, and (3) a low cycle fatigue crack propagation study of 5Ni-Cr-Mo-V steel in dry and wet environments in which considerable microcrack formation and growth was encountered. Author (TAB)

N66-20851# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
CRACK INITIATION IN METALLIC MATERIALS Quarterly Progress Report No. 1
V. Weiss, G. Nash, and K. Schroder Jun. 1965 24 p refs
(Contract NOw-65-0355-d)
(MET.E-1289-63065P1)

The values of the crack initiation parameter N_o obtained in these studies were found to agree well with the relation between the applied stress, stress concentration factor, and N_o value postulated in the previous final report. Also the value of the parameter n+, which is related to the crack propagation characteristics of the material, were in excellent agreement with the previous values obtained. Studies of crack initiation in 7075 aluminum under monotonic tensile loading have commenced using an acoustical method and electrical resistance measurements for the detection of the pop-in load. The acoustical method thus far seems to be the most promising; the major difficulty experienced with the resistance measurements has been a too high electrical noise level. Photographs are being taken while the specimen is under load in an attempt to correlate the observed acoustic signals with crack initiation and slow growth. Author

N66-20876*# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
ADHESION BETWEEN ATOMICALLY PURE METALLIC SURFACES. PART IV: THE EFFECT OF CONTAMINATION ON THE ADHESION OF METALLIC COUPLES IN ULTRA-HIGH VACUUM Semi-Annual Report
K. I. Johnson and Douglas V. Keller, Jr. Jan. 1966 42 p refs (Grant NsG-483)
(NASA-CR-71147; SURI-MET-1100-661SA) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The presented work is concerned with determining the factors controlling the adhesion of metal couples. Adhesion experiments show that contaminant dispersal is the major barrier to adhesion. Thus, spontaneous adhesion occurred under vacuum conditions for the three systems studied when the surfaces were sufficiently clean, whereas subsequent contamination resulted in non-adhesion. Substantial amounts of contamination could, however, be tolerated. The contaminants may be divided into two classes, stable surface films and mobile gaseous or liquid films. Because adhesion occurred for clean surfaces under vacuum conditions, even where elastic deformation predominated, the postulated energy barrier of adhesion due to the realignment of the surface atoms is considered of minor importance, at least for the softer metals studied here. Further, no evidence for rupture of the bonds by the elastic relief forces on unloading such lightly loaded clean couples has been observed. The latter effect, however, is thought to become more important whenever stable surface films are present, because of the limited metal-metal contact. Since the one immiscible system studied here showed as great a tendency to adhesion as the miscible systems, the condition of bulk miscibility is considered no criterion, per se, for adhesion. Author

N66-21018*# Vitro Labs., West Orange, N. J.
DEVELOPMENT OF OXIDATION RESISTANT COATINGS FOR USE ABOVE 3500°F
P. F. Campbell, K. A. Gebler, and M. H. Ortner Sep. 1965 83 p refs
(Contract NAS9-3413)
(NASA-CR-65285) CFSTI: HC $3.00/MF $0.75 CSCL 11F

The physical properties of a number of oxidation resistant coating materials for protecting tantalum-base alloys at temperatures above 3500°F are reviewed and summarized in a table. Also tabulated is information on the sources of supply from which the materials were obtained, and the results of chemical analysis of the powders. Investigated were coating rates; particle size effects; the sintering of pure oxides; pure intermetallics; and composite pellets. Metallic binders for ZrB_2 and $MoSi_2$ coatings were also studied. Tungsten disilicide was investigated as a base coating material, and sintering studies of refractory oxides are also reported. Photomicrographs of several sintered oxides are presented along with a photograph of a high temperature oxidation test furnace, and a schematic diagram of an experimental induction-heated vertical zirconia muffle furnace. L.S.

N66-21105# IIT Research Inst., Chicago, Ill.
EVALUATION OF THERMAL PROTECTIVE SYSTEMS FOR ADVANCED AEROSPACE VEHICLES. VOLUME II: APPENDICES Interim Summary Report, Sep. 1962–Dec. 1963
W. J. Christian, J. L. Bliton, J. W. Daily, J. C. Hedge, H. J. Hirschhorn et al Wright-Patterson AFB, Ohio. AF Mater. Lab., Apr. 1965 579 p refs
(Contract AF 33(657)-9407)
(ML-TDR-64-204; Vol. II; AD-627240) CFSTI: HC $8.80/MF $2.25

The report contains summaries of: Surveys of the literature on structural and design aspects of thermal protection systems, on compatibility of refractory materials, on thermal and mechanical properties of refractory materials, and on methods for measuring emittance of materials at high temperature. Experimental determination of the thermal conductance of plasma sprayed coatings of alumina-nickel and zirconia Nichrome types. Measurements of total normal emittance of materials in an oxidizing atmosphere at temperatures of 1000 to 4000°F. Experimental investigations of the effects of composition on the thermal expansion and total normal emittance of zirconia and magnesia. Analytical and experimental studies of the general characteristics and weight requirements of transpiration cooled nose caps using porous metal surfaces. Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-19816# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOTOR AND JET OILS AND FLUIDS Selected Chapters
K. K. Papok and Ye G. Semenido 29 Dec. 1965 151 p refs Transl. into ENGLISH from the Book "Motornyye i Reaktivnyye Masla i Zhidkosti" Moscow, izd. "Khimiya", 1963 p 123-139, 224-236, 391-398, 411-462, 544-552, 673-691
(FTD-MT-64-382; AD-626977) CFSTI: HC $5.00/MF $1.00

Contents: Viscosity additives, Multifunctional additives, Diesel oils, Oils for turbojet and turboprop engines, Oils for gas turbines, Oils for rocket engines, Plastic lubricants and their structure, and Liquids for engine-cooling systems. TAB

N66-19881# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INVESTIGATION OF THE THERMOPHYSICAL PROPERTIES OF CHAMOTTE CERAMICS IN THE 80–1200°K RANGE
L. L. Vasil'ev and Iu. E. Frasman [1965] 10 p refs Transl. into ENGLISH from Inzh.-Phys. Zh. (USSR), v. 9, no. 5, 1965 p 762–767

Coefficients for heat conductivity, temperature conductivity, and specific heat of chamotte ceramics were computed from known thermodynamic characteristics in air, extended and compared to experimental results obtained in various gas media. Thermophysical characteristic measurements of rod shaped ceramic samples in a low-vacuum cryostatic apparatus at 80° to 500° K showed a 5% comparitive error. High-temperature testing in a furnace of 500° to 1200° C gave an 8% comparative error for the heat conduction coefficient. Experimental and computed values of the coefficients of heat conduction for the ceramic's components, as well as the coefficients of its effective heat condution in different gas media are presented in a table. The greatest discrepancy between computed and experimental established values were found for freon-12 and attributed to direct gas flow in the ceramic caused by pressure gradients. G.G.

N66-19910# Rock Island Arsenal Lab., Ill. Research and Engineering Div.

SEMI-INORGANIC HEAT RESISTANT ELASTOMERS BASED ON BORON

Lynn G. Wiedenmann Nov. 1965 16 p refs

(RIA-65-3182; AD-626581) CFSTI: HC $1.00/MF $0.50

The preparation of high temperature resistant elastomers containing boron was attempted. A copolymer obtained from dimethyldichlorosilane and 1,1':2,2'-bis- (chloromethylsilylene) -bis 1,2-dicarbadodecaborane (12) cured into a resin. An air oven aged sample showed an equilibrium weight loss of 9 percent at 316° C (40 hours) and 23 percent at 450° C (2 hours). An elastomeric chain copolymer (MW 68,000) obtained from the reaction of bis (chlorodimethylsilyl) 1,7-dicarbadodecaborane with octamethyl cyclotetrasiloxane lost its elasticity after air oven aging 2.5 hours at 316° C (weight loss 7.3 percent). Author (TAB)

N66-19950 Joint Publications Research Service, Washington, D. C.

THE USE OF POLYURETHANE FOAM IN MAKING SOLAR ENERGY COLLECTORS

S. N. Vil'kova, I. A. Novikova, and D. Alvutdinov *In its* Heliotechnology 28 Feb. 1966 p 23-26 refs (See N66-19946 10-03) CFSTI: $3.00

Mixtures of sebacic and adipic acids with toluylene diisocyanate were used to produce a fine porous polyurethane foam for the manufacturing of 280 mm and 410 mm diameter paraboloid collectors. Hexagonal polyurethane foam facets were formed in aluminum molds, and mirror surfaces were produced by cementing thin epoxy mirrors onto the facets. A collector mock-up model containing 19 facets for a total surface area of 1444 cm^2 was constructed and tested for light and weather resistance during June and July. Collector receiver temperature for the two months fell 135°C due to injury of the transferred aluminum surfaces. The strength of the polyurethane foam backing was not effected. G.G.

N66-20162# Office of Naval Intelligence, Washington, D. C. Translation Section.

PLASTIC SHIP HULLS

V. V. Kushlev and I. A. Sokolov [1964] 104 p refs Transl. into ENGLISH of the Book "Korpusa Sudov Iz Plastmass" Leningrad, State Union Publishing House for the Shipbuilding Ind., 1960

(ONI-TRANS-1094; AD-627249) CFSTI: HC $4.00/MF $0.75

The book describes the use of reinforced plastics for building ships' hulls and cites data on the materials used on hull structures, and the technology involved in building the hull. The book is for engineers and shipbuilding technicians working in the field of planning and building plastic ships. Author (TAB)

N66-20183# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

INVESTIGATION OF CATALYTIC THERMAL OXIDATIVE DEGRADATION OF ORGANIC POLYMERS AT ELEVATED TEMPERATURES

D. G. Flom, A. L. Speece, and G. A. Schmidt Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1965 122 p refs

(Contract AF 33(657)-11240)

(AFML-TR-65-235; AD-626847) CFSTI: HC $4.00/MF $0.75

The basic mechanisms of degradation of organic polymers at elevated temperatures in contact with certain metals were investigated. The areas of study included migration of metal into polymers, the role of metal oxide films in degradation, polymer-metal reactions, and inhibition of degradation by the use of inert metal coatings. The polymers considered were epoxies, phenolics, and polybenzimidazole. The metals used were aluminum, iron, and stainless steel. Composite configurations evaluated were lap shear specimens and fine metal powders dispersed in the polymers. The experimental techniques used included mass spectrometry, neutron activation analysis, infrared absorption, electron paramagnetic resonance, thermochemiluminescence, and vapor phase chromatography. Author (TAB)

N66-20237# Hanford Atomic Products Operation, Richland, Wash.

ELECTRICAL SEAL TESTS Final Report

H. F. Jensen 4 Feb. 1965 7 p

(Contract AT(45-1)-1350)

(HW-65182RD) CFSTI: HC $1.00/MF $0.50

Tests were made to determine leakage rates at 5 and 15 psi when the Rockbestos NPR control cable was filled with various silicones as sealants. Similar tests were made on conduits sealed with Eureka foam and silicones, and on single wires sealed with solder. NSA

N66-20340# California Univ., Livermore. Lawrence Radiation Lab.

THE EFFECT OF STRAIN RATE ON THE MECHANICAL PROPERTIES OF GENERAL PURPOSE POLYPROPYLENE

K. G. Hoge 9 Jul. 1965 21 p refs

(Contract W-7405-ENG-48)

(UCRL-14316) CFSTI: HC $2.00/MF $0.50

The effect of strain rate on the mechanical properties or polypropylene is analyzed. Compressive data were obtained at "static" strain rates from 10^{-4} to 1 per second and at dynamic rates from 650 to 1600 per second on a Dynapak machine utilizing the Hopkinson split-bar technique. The effect of friction on the specimen ends, which produces a triaxial stress state, is analyzed by comparing unlubricated specimens and specimens lubricated with Molykote. Photographs of tests were taken with high speed cameras at 50-μsec intervals to show the mode of deformation. Author (NSA)

N66-20390# National Inst. for Research in Nuclear Science, Harwell (England). Rutherford High Energy Lab.

SOME PRESSURE TESTS ON CIRCULAR AND RECTANGULAR DIAPHRAGMS OF POLYETHYLENE TEREPHTHALATE FILM

A. J. Middleton Mar. 1965 21 p refs

(NIRL/R/93) HMSO: 3s 6d

Bursting pressures and deflections of laminated membranes made from biaxially oriented polyethylene terephthalate film (Melinex and Mylar) were investigated for high energy and nuclear physics applications. Burst pressures of 1000 psi for a 5 inch port were achieved. Methods of clamping are discussed and effect of creep on life was estimated. Author (NSA)

N66-20426# Sandia Corp., Albuquerque, N. Mex.
DIFFERENTIAL THERMAL ANALYSIS OF FLEXIBLE POLYURETHANE FOAMS. I. TRANSITIONS AND THEIR EFFECT ON STRESS-STRAIN PROPERTIES
Peter B. Rand Jan. 1965 22 p refs
(Contract AT(29-1)-789)
(SC-DR-64-1782) CFSTI: HC $1.00/MF $0.50

The glass transition temperatures (T_g) of four flexible polyurethane foams were determined by differential thermal analysis. Glass transition temperatures were also determined from stress-strain curves obtained over a temperature range of −57° C to 22° C and compared with DTA values. Author (NSA)

N66-20670# Rock Island Arsenal Lab., Ill. Research and Engineering Div.
TWO YEAR AGING OF ELASTOMERIC VULCANIZATES IN PANAMA, ALASKA AND ILLINOIS
E. W. Bergstrom Sep. 1965 32 p
(RIA-65-2374; AD-626697) CFSTI: HC $2.00/MF $0.50

Vulcanizates prepared from commercially available elastomers, many of which have been introduced since 1955, were exposed outdoors at Ft. Wainwright, Alaska, Rock Island, Illinois and the Panama Canal Zone to compare the effects of arctic, temperate and tropic environments over a ten year period. Unstressed test pads and bent loop oxone specimens were used. Results after two years indicate that aging is generally more severe in Panama than in Alaska or Rock Island, although some vulcanizates have shown excellent aging resistance at all three exposure sites. SE 555U high strength silicone (if unpigmented) suffers a severe loss in tensile strength when aged outdoors. Bent loop specimens of EPM (MD460), Hycar 4021 and Genthane SR, all chemically saturated elastomers, have cracked within two years in Panama (all three types) and Rock Island (EPM and Hycar 4021). Author (TAB)

N66-20861# Oklahoma Univ. Research Inst., Norman.
THE EFFECT OF RESIN CONTENT AND VOIDS ON THE STRENGTH OF FIBERGLASS-REINFORCED PLASTICS FOR AIRFRAME USE Final Report, Apr. 9, 1964–Mar. 31, 1965
Gene M. Nordby, W. C. Crisman, and Charles W. Bert Nov. 1965 99 p refs
(Contract DA-44-177-AMC-164(T))
(USAAVLABS-TR-65-66; AD-627362) CFSTI: HC $3.00/MF $0.75

As a further step toward the acceptance of fiberglass reinforced plastics (FRP) in primary aircraft structure, the effects of resin content on laminate strength properties were investigated in depth. Functional relationships were obtained and methods of controlling resin content were compared. Uniformity in strength and resin content was observed from the point of view of replication and within-laminate conditions. Most of the data were for laminates of EPON 828-Z eopoxy resin reinforced with the 181 style fiberglass fabric; however, limited data were obtained for the 120 and 909 (S-920) fabrics. In addition, a preliminary study was made of the effects of voids in the cured laminates. A critical size was observed for large artificial voids, and the microvoid content of the prepreg was minimized by modification of a previously developed multiply coating machine. Nondestructive methods of testing for voids were also reviewed. Author (TAB)

N66-20883# California Univ., Los Angeles. Dept. of Chemistry.
GLASS TRANSITIONS IN IONIC POLYMERS
A. Eisenberg, H. Farb, and L. G. Cool 20 Nov. 1965 25 p refs *Its* Contrib. No. 1890
(Contract Nonr-233(87))
(TR-10; AD-625330) CFSTI: HC $1.00/MF $0.50

The glass transition temperatures of an inorganic anionic phosphate polymer system was studied over a wide range of counterions. It was shown that the glass transition temperature could be varied between −10° C to +520° C, and that a plot of the glass Transition Temperature versus the ratio of the cation change (g) to internuclear distance between the cation and the oxygen on the polymer backbone ('a') yielded a straight line over the entire temperature range; a theoretical justification for this linearity was presented. It was further shown that the increase in the glass transition with (g/a) is due not only to an increase in the interchain forces, but also to an increase in the carrier to internal rotation between neighboring groups. Author (TAB)

N66-20897*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INVESTIGATION OF THE EFFECT OF MATERIAL PROPERTIES ON COMPOSITE ABLATIVE MATERIAL BEHAVIOR Third Quarterly Report, Dec. 11, 1965–Mar. 10, 1966
F. E. Schultz [1966] 30 p refs
(Contract NAS3-6291)
(NASA-CR-71295) CFSTI: HC $2.00/MF $0.50 CSCL 11D

Variations in thermal properties due to processing and fabrication techniques upon silica cloth/phenolic resin, graphite cloth/phenolic resin, and graphite cloth/epoxy resin were investigated through an extensive literature search of existing data, and by determining the influences and limitations of changes in lamination angle, resin contact, density, and lot-to-lot variations upon surface recession of the investigated materials. In general, increase in resin content decreased the thermal conductivity of graphite-phenolic laminates but did not effect that of selica-phenolic cloth. Thermal conductivity of all materials was more dependent upon the lamination angle than on the resin or the fiber content. Orientation angle and resin content had no great influence on heat coefficients; lot-to-lot variations masked out any property interrelationship. It was found that silica phenolic had the lowest thermal conductivity and specific heat coefficient. G.G.

N66-20980# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.
EXPLOSION HAZARDS OF AMMONIUM NITRATE UNDER FIRE EXPOSURE
Robert W. Van Dolah, C. M. Mason, F. J. P. Perzak, J. E. Hay and D. R. Forshey 1966 93 p refs
(BM-RI-6773)

An attempt has been made to define the conditions under which ammonium nitrate (AN) might detonate as a result of involvement in fire. The initiation of detonation by shocks derived from explosives or from projectile impact was investigated as a function of temperature and charge diameter. A new technique was devised to investigate the burning of raw and contaminated AN under pressure. No transition to detonation in AN was obtained in the burning experiments. The critical diameter for detonation of fertilizer-grade AN was found to be quite small when the AN was at temperatures just below melting point; this indicates that initiation of detonation may be less difficult at elevated temperatures but such initiation by gas-phase detonation was shown to be unlikely. Transition from burning to detonation was obtained

with AN intimately mixed with fuels that included polyethylene, paper, and fuel oil when these were contained in vessels with restricted vents. However, the experimental results supported by an analytical study indicate that the initiation of detonation in AN from fire exposure in normal storage and from transportation incidents is quite improbable. The detonation of AN in recent incidents more likely may have resulted from the effects of adjacent explosions. Author

N66-21000*# TRW Systems Group, Redondo Beach, Calif.
THE SOLAR REFLECTANCE AND/OR HEMISPHERICAL EMITTANCE OF SELECTED SPACE SUIT MATERIALS
Jerry T. Bevans 15 Jul. 1965 232 p refs
(Contract NAS9-3684)
(NASA-CR-65244; TRW-5324-6001-SU-000) CFSTI: HC $6.00/MF $1.75 CSCL 11E

The solar reflectance as a function of the angle of incidence and the total hemispherical emittance are reported for a number of selected space suit materials. Among the materials examined are rayon fabric dipped in teflon containing a pigmentation of magnesium oxide; a fine weave HT-1 nylon fabric with 3M aluminized coating in one side; and a 0.45 mil polypropylene layer laminated to a 0.18 mil layer of aluminum foil. C.T.C.

N66-21002*# Meteorology Research, Inc., Altadena, Calif.
STUDY OF HEAT SENSITIVE RADIOISOTOPES FOR TEMPERATURE MEASUREMENT APPLICATION Final Report
H. D. Hutchinson Jul. 1965 49 p
(Contract NAS9-3403)
(NASA-CR-65264; MRI65-FR-283) CFSTI: HC $2.00/MF $0.50 CSCL 07E

A research program to experimentally select a series of carrier materials which decompose at fixed temperatures in the range 300°F to 1200°F is reported. These provide a means of continuously tracking the propagation front of an isothermal surface through a virgin nose cone material. This study of heat-sensitive radioisotopes for temperature measurement is an extension of the RMS-3A radioactive ablation sensor system which is based on a radioactive source emitting gamma rays, a Geiger-Muller detector tube, and solid state electronic circuits. Essentially, the same system is employed to sense a temperature front rather than an ablation front by using a linear radioactive source. Relative to use with this system various investigations were made of heat sensitive carrier compounds. The compounds suitable for use are given along with their effective temperature range, and include anthraquinone; hexamethylene; ammonium tartrate, chloride, sulfate, and iodide; sodium chlorate; potassium metaperiodate and perchlorate; and sodium bisulfite. C.T.C.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-19800# California Univ., Berkeley. Operations Research Center.
DUALITY IN MATHEMATICAL PROGRAMMING
Stepan Karamardian Jan. 1966 89 p refs
(Grant NSF GP-4593)
(ORC-66-2)

Consideration is given to symmetric dual nonlinear mathematical programs, and a monotonicity property is established for the combined constrain mapping. Using Kakutani's fixed point theorem for an upper semi-continuous point to set mapping, a uniqueness and an existence theorem of Cottle's composite program are obtained. Minimax and duality are discussed in terms of quasi and strict quasi-convex functions, as well as duality and the relationship between dual programs. A forward duality theorem is obtained which does not require strict concavity. M.W.R.

N66-19814# RAND Corp., Santa Monica, Calif.
GEOMETRIC ASPECTS OF OPTIMAL CONTROL THEORY WITH DISCONTINUITIES
Russell D. Shaver Jan. 1966 240 p refs
(P-3289; AD-626650) CFSTI: HC $6.00/MF $1.25

Modern control theory and the study of discontinuities, i.e., sudden changes in the states of a system, in the controls, in the forcing functions, and in the payoff function are examined for the purpose of clarifying and simplifying the theory of optimal control. The classical rocket problem where the vehicle is assumed to have two stages and where the location where staging occurs is a specified function of the mass burned is considered in detail. The manner of attacking the problem is designed to illustrate the nature of the conditions developed in the thesis. E.E.B.

N66-19821# Wisconsin Univ., Madison. Dept. of Statistics.
THE USE OF SECOND ORDER "SPHERICAL" AND "CUBOIDAL" DESIGNS IN THE WRONG REGIONS
Norman R. Draper and Willard E. Lawrence (Marquette Univ.) Nov. 1965 10 p refs Prepared in cooperation with Marquette Univ.
(Contract Nonr-1202(17))
(TR-57; AD-626854) CFSTI: HC $1.00/MF $0.50

The selection of a suitable design for fitting a second order polynomial model when the region of interest was a unit sphere in the coded k-dimensional space of k factors was previously discussed. Also, the selection of suitable second order designs when the region of interest was a k-dimensional cuboid was previously examined. The purpose of this investigation was to determine the effects of using a cuboidal design in a spherical region or a spherical design in a cuboidal region. It was found that in a minority of cases the wrong design produced a smaller total variance plus bias than the correct design. It was concluded that when bias error is not an important factor the correct design is, in most cases, better. When the bias error is an important factor, the correct design is always better. E.E.B.

N66-19824# Wisconsin Univ., Madison. Dept. of Statistics.
MISSING VALUES IN MULTIVARIATE STATISTICS. II: POINT ESTIMATION IN SIMPLE LINEAR REGRESSION
A. A. Afifi and R. M. Elashoff (Calif. Univ., Berkeley) Jul. 1965 24 p refs Prepared in cooperation with Calif. Univ.
(Contract Nonr-1202(17); Grants NSF CP-2593; PHS-43-64-562; PHS-GM-10525)
(TR-53; AD-626851) CFSTI: HC $1.00/MF $0.50

In this paper, the authors study the probabilistic behavior

of several ways to estimate the linear regression function between two random variables. They derive the mean square error of prediction for each method of estimation. Tables are given to characterize in terms of the correlation coefficient those situations where a given method has smaller mean square error than its competitors. TAB

N66-19844# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ALL-UNION CONFERENCE ON COMPUTER MATHEMATICS

N. S. Bakhvalov and A. N. Tikhonov 6 Jan. 1966 7 p Transl. into ENGLISH from Usp. Mat. Nauk (Moscow), v. 20, no. 3, 1965 p 254–255

(FTD-TT-65-1807/1+4; AD-626969) CFSTI: HC $1.00/MF $0.50

The Conference was held in Moscow from 22 to 26 January, 1965. About 2000 persons took part in the conference and more than 300 reports were heard. The work of the conference was divided into the following sections: (1) Computer methods of algebra, quadratures and approximation of functions; (2) numerical methods for solving ordinary differential equations; (3) numerical methods for solving equations with partial derivatives; (4) numerical methods for solving integral and functional equations; (5) methods for solving optimum problems; (6) numerical methods for solving incorrectly stated problems; (7) numerical methods for solving problems of mechanics; (8) numerical methods for solving problems of physics and chemistry. TAB

N66-19845# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN INTEGRAL INEQUALITIES AND THE SOLVABILITY OF DEGENERATING QUASILINEAR ELLIPTIC SYSTEMS OF DIFFERENTIAL EQUATIONS

Yu. A. Dubinskiy 6 Jan. 1966 31 p refs Transl. into ENGLISH from Mat. Sb. (Moscow), v. 64, no. 3, 1964 p 458–480

(FTD-TT-65-1808/1+4; AD-626970) CFSTI: HC $2.00/MF $0.50

Theorem proofs for integral inequalities in both, a bounded region and in a whole space are presented. These integral inequalities are used as the basis for theorem proofs showing the solvability of the first boundary problem for degenerating quasilinear elliptic systems of differential equations of the order 2m. The conditions for ellipticity are formulated. L.S.

N66-19850# Research Analysis Corp., McLean, Va.

A GENERAL THEORY OF FINITE SEQUENTIAL DECISION PROCESSES

Peter C. Fishburn Feb. 1965 32 p refs

(Contract DA-44-188-ARO-1)

(RAC-TP-143; AD-625048) CFSTI: HC $2.00/MF $0.50

This paper discusses the structure and analysis of sequential decision processes within the restriction of a formulation involving only finite sets. A definition of the phrase 'finite sequential decision process' is presented, using the notions of action sets, outcome sets, conditional probabilities, histories, and availability functions. To the best of our knowledge this formulation is more general than any presented to date, and it is designed to fill an existing gap in the literature of sequential decision processes. The latter part of the paper examines special conditions of homogeneity, availabilities, probabilities, and utilities that reduce the general process to special cases, some of which have been discussed in the literature. Along the way a general expected-utility decision model is presented for the general finite process. The model is based on utilities of terminal histories and probabilities of terminal histories conditioned by strategies. The definition of strategy is based on the notion of decision functions for the various stages of the process. A backward-computational approach for obtaining optimal decision functions is discussed. Author (TAB)

N66-19851# State Univ. of New York at Buffalo. Div. of Interdisciplinary Studies and Research.

CREEP OF CIRCULAR PLATES WITH TEMPERATURE GRADIENTS Summary Report

F. A. Cozzarelli May 1965 34 p refs

(Contract Nonr-4449(00))

(Rept.-5; AD-625685) CFSTI: HC $2.00/MF $0.50

An analysis of creep bending in circular plates with temperature gradients is presented in this paper. The analysis is based on a creep power law in which the creep parameter is expressed as a function of temperature. Governing equations are developed for plates subjected to radially symmetric loads and temperatures. Complete moment and deflection solutions are obtained by an iterative technique for simply supported plates subjected to linear radial temperature distributions and uniform lateral loads. Author (TAB)

N66-19961# Carnegie Inst. of Tech., Pittsburgh, Pa. Management Sciences Research Group.

STRUCTURAL SENSITIVITY ANALYSIS IN LINEAR PROGRAMMING AND AN EXACT PRODUCT FORM LEFT INVERSE

W. W. Cooper and A. Charnes (Northwestern Univ.) 15 Dec. 1965 11 p refs Prepared jointly with Northwestern Univ. *Its* Management Sci. Res. Rept.-62 and Systems Res. Memo 141

(Contracts Nonr-760(24); Nonr-1228(10))

(AD-626982) CFSTI: HC $1.00/MF $0.50

This paper shows how to obtain an exact inverse in the form of a product modification to a given inverse when the matrix has been altered additively by a matrix of a certain class. Explicit formulae are derived for sensitivity analyses, e.g., in linear programming, wherein the elements of the structural matrix are to be varied. Author (TAB)

N66-20033# United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.

CONVECTIVE DIFFERENCE SCHEMES

K. V. Roberts and N. O. Weiss Apr. 1965 41 p refs Submitted for Publication

(CLM-P76)

General methods are developed for numerical solution of the partial differential equations for the convection of a scalar, i.e., density, or a vector, i.e., magnetic field. The difference schemes are correctly centred in both space and time so that the modulus of the amplification factor is exactly unity. They are also conservative and have fourth order accuracy. The methods are applicable in two or three space dimensions and on curvilinear as well as Cartesian meshes. They can be used for either linear or non-linear problems. Author

N66-20063# Lockheed Missiles and Space Co., Sunnyvale, Calif.
EXTENSION OF FLOQUET'S THEOREM TO NONLINEAR EQUATIONS
A. A. Sharshanov [1966] 24 p refs Transl. into ENGLISH from Ukr. Mat. Zh., (Kiev), v. 11, no. 4, 1965 p 413–430

A method is proposed for analyzing differential equations with explicit periodic time dependence. It is shown that a system of two linear equations with periodic coefficients may be compared to a system of two linear equations with constant coefficients so that under identical initial conditions the values of the solutions of the first and second systems will agree for values of t equal to an integer number of periods. The problem is formulated rigorously and solved on the basis of the theory of analytic iterations of functions. The objects for iteration are the functions u(x,y) and v(x,y). These express the dependence of values for the solutions of the original system of equations at the end of the period in terms of values for the solutions x and y at the beginning of the period. C.T.C.

N66-20094# Rutgers Univ., New Brunswick, N. J. Statistics Center.
CHAIN SAMPLING INSPECTION PLANS—ChSP-0,3 AND ChSP-1,3
K. S. Stephens and H. F. Dodge Dec. 1965 21 p refs
(Contract Nonr-404(18))
(N-22; AD-625886) CFSTI: HC $1.00/MF $0.50

This report extends the evaluation and presentation of the statistical properties of 'two-stage' chain sampling inspection plans to pairs of acceptance numbers of 0,3 and 1,3; plans with acceptance numbers of 0,2; 1,2; and 0,1 are covered in earlier reports. Included are a number of Markov Chains used in the evaluation of the operating characteristics. Also included is a brief discussion of the comparison between chain and single sampling plans. Author (TAB)

N66-20125# Wisconsin Univ., Madison. Dept. of Statistics.
BAYESIAN COMPARISON OF MEANS OF A MIXED MODEL WITH APPLICATION TO REGRESSION ANALYSIS
George C. Tiao Apr. 1965 37 p refs
(Contract Nonr-1202; Grant NSF GS-151)
(TR-49; AD-625271) CFSTI: HC $2.00/MF $0.50

In the present paper, we adopt a Bayesian approach to the problem of making inferences about the means of a two way mixed model. Although only a rather simple model is considered, the method of analysis can be readily extended to more complicated ones. The joint posterior distribution of the parameters in the model is obtained under the usual assumption of normality, independence, and a non-informative prior distribution. We then study the problem of comparing two means. It is shown that the criterion for comparison follows a modified student-t distribution. This allows the investigator to extract more information from the data than what is usually possible in the sampling theory framework. A procedure with similar properties for an overall comparison of more than two means is derived. Finally, we extend our analysis to regression models with variance-components appearing in the error term. Author

N66-20172# Stanford Univ., Calif. Computer Sciences Dept.
ON THE APPROXIMATION OF WEAK SOLUTIONS OF LINEAR PARABOLIC EQUATIONS BY A CLASS OF MULTISTEP DIFFERENCE METHODS
Pierre Arnaud Raviart 6 Dec. 1965 62 p refs
(Contract Nonr-225(37))
(CS31; AD-626315) CFSTI: HC $3.00/MF $0.75

Evolution equations are considered of the form

$$\frac{du(t)}{dt} + A(t)\,u(t),\ 0 \le t \le T,\ f \text{ given},$$

with the initial condition $u(0) = u_0$ u_0 given where each A(t) is an unbounded linear operator in a Hilbert space H, which is in practice an elliptic partial differential operator subject to appropriate boundary conditions. TAB

N66-20269# California Univ., Berkeley. Lawrence Radiation Lab.
THE METHOD OF BOOLEAN SIGNATURES: AN APPLICATION OF BOOLEAN ALGEBRA TO THE STATISTICAL ANALYSIS OF EXPERIMENTS
Alan Natapoff 5 May 1964 21 p refs
(Contract W-7405-ENG-48)
(UCRL-11408) CFSTI: HC $1.00/MF $0.50

A method is presented that simplifies the physical content of an experimental result by removing a maximal number of redundant variables. A set of N primary binary variables is postulated to characterize each event of the sample, and an N-bit binary signature is constructed that summarizes the behavior of each event relative to these N variables. For well chosen variables and an unbiased experimental sample, the sets of signatures occurring frequently can be uniquely decomposed into physical subsets if an appropriate kind of physical relation holds among the variables. This gives a global picture of the correlations among the basic variables, facilitates the separation of real from background events and gives a physical picture of the physical channels contributing to the experimental distribution. The Boolean minimization approach initiated by Quine is used and the calculations are performed, for large problems, by a computer. A detailed example from high energy physics is given. Author (NSA)

N66-20326# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
TABLES OF ELLIPTIC INTEGRALS
William Joel Nellis (M.S. Thesis) May 1965 46 p refs
(Contract W-7405-ENG-82)
(IS-T-14) CFSTI: HC $2.00/MF $0.50

The tables present a method of evaluating elliptic integrals of the first and second kinds by means of the R function, a hypergeometric function of several variables. The general method is to reduce an integral of elliptic type to an R function by means of given integral formulas. Formulas for complete or incomplete integrals are then used to reduce the R function to a linear combination of two standard R functions and an algebraic function. The two standard functions, R_D and R_E (in the complete case) or R_F and R_G (in the incomplete case) are normal elliptic integrals of the first and second kinds. Numerical values of the normal integrals over a limited range are given. Elliptic integrals of the third kind (as well as many other integrals) can also be expressed in terms of the R function, but tables for reduction and numerical evaluation of integrals of the third kind are not included. Author (NSA)

N66-20356# Oak Ridge National Lab., Tenn.
TWO ALGORITHMS OF ROMBERG TYPE FOR ORDINARY INITIAL-VALUE PROBLEMS

William B. Gragg [1964] 5 p refs Presented at IFIP Congr. 1965 Meeting, New York
(ORNL-P-1303; CONF-650505-3) CFSTI: HC $1.00/MF $0.50

The existence of simple discretizations of both first and special second order systems, which have an asymptotic expansion in powers of h^2, is shown. Two algorithms of Romberg type are obtained. NSA

N66-20444# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT OF THE MAPPING FUNCTION AT A CORNER
Neil M. Wigley 1964 47 p refs Submitted for Publication
(Contract W-7405-ENG-36)
(LA-DC-6558) CFSTI: HC $2.00/MF $0.50

Let D be a domain in the plane which is partially bounded by two curves Γ_1 and Γ_2 which meet at the origin and form there an interior angle $\pi\tau > 0$. Let N be an integer ≥ 2 and let α be a number such $0 < \alpha < 1$. Suppose that for $i = 1, 2$, Γ_i admits a parameterization $x = x_i(t)$, $y = y_i(t)$, $0 \leq t \leq 1$, where x_i and y_i have N-th derivatives which are uniformly α-Hölder continuous, and $|x_i'(t)| + |y_i'(t)| > 0$. Let G(z) map the sector $0 < \arg z < \pi\tau$ conformally onto D in such a way that $G(0) = 0$. Then if τ is irrational G(z) has an asymptotic expansion in powers of z and $z^{1/\tau}$, with error term $o(z^{N-\epsilon})$. If $\tau = p/q$, a reduced fraction, then G(z) has an asymptotic expansion in powers of z, $z^{1/\tau}$, and $z^q \log z$, with error term $o(z^{N-\epsilon})$. In both cases ϵ is an arbitrarily small positive number. Furthermore expansions for derivatives of G(z) or order $\leq N$ may be obtained by differentiating formally. Author (NSA)

N66-20597# Boeing Scientific Research Lab., Seattle, Wash. Mathematics Research Lab.
MONOTONICITY OF RATIOS OF MEANS AND OTHER APPLICATIONS OF MAJORIZATION
Albert W. Marshall, Ingram Olkin (Stanford Univ.), and Frank Proschan Dec. 1965 24 p refs *Its* Math. Note. No. 436 Also issued as Stanford Univ. Tech. Rept.-20
(Grant NSF GP-3837)
(D1-82-0490; AD-627187) CFSTI: HC $1.00/MF $0.50

Monotonicity of a ratio can be viewed as a form of total positivity. The theory of total positivity is exploited to obtain more general results. The proof of monotonicity is based on a theorem giving sufficient conditions for majorization. Several other applications of the majorization theorem are given. One application concerns a stochastic comparison between a function of order statistics from a distribution with increasing failure rate average and the same function of the order statistics from the exponential distribution. Another application is to a comparison between the condition number of a positive definite matrix and the condition number of a polynomial in the matrix. TAB

N66-20608 Joint Publications Research Service, Washington, D.C.
HYBRID FUNCTIONS—THE NEW METHOD OF DESCRIPTION OF COMPLEX SYSTEMS
O. R. Terno *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 19–27 (See N66-20606 10-10) CFSTI: $6.00

For the joining of the processes, events and logical relationships between the complex systems into the united system of equations, it is proposed that we use the hybrid functions which are the product of the functions of real variables and predicate functions. The truth of the predicate functions is taken as one, false is zero. As an example, a description is given of a thrust problem in a power system. Author

N66-20611 Joint Publications Research Service, Washington, D. C.
ON THE OPTIMAL PRIORITIES IN QUEUEING SYSTEMS
O. I. Bronstein and V. V. Rykov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 40–54 refs (See N66-20606 10-10) CFSTI: $6.00

For certain one-line queueing systems with priorities and flows which are different with respect to requirement values, some series of priorities in servicing are found which ensure the operation of the systems in the steady state condition which is optimal with respect to the economic criterion. Author

N66-20664# Cekmece Nuclear Research Center, Istanbul, (Turkey).
CORRELATIONS IN PLASMAS. PART III: GREEN'S FUNCTION SOLUTIONS FOR CORRELATION FUNCTIONALS IN BOGOLIUBOV THEORY
Kaya Imre and Ercüment Ozizmir Jan. 1964 30 p refs
(CNAEM-13) CFSTI: HC $2.00/MF $0.50

A method which uses a set of eigendistributions in constructing the formal solution of the set of integro-differential equations for the correlation functionals in the context of the Bogoliubov formalism for fully ionized systems interacting via the Coulomb potential is displayed to an arbitrary order in the interaction strength for the homogeneous case. It is indicated that the method is equally applicable to the slightly inhomogeneous systems for which a perturbation series solution can be developed formally. It is also possible to apply this method in solving the initial value problem of the BBGKY hierarchy. The eigendistributions employed are those developed by Van Kampen and Case in connection with the linearized Vlasov equation. Although the resulting Green's function is quite complicated, it exhibits the general structure of the solutions. Author

N66-20674# Naval Research Lab., Washington, D. C.
FIVE-FIGURE TABLE OF THE FUNCTIONS 1/(1-TAN θ) AND 1/(1-COT θ) FOR THE RANGE −90°, (1°) 90°
W. K. Gardner and E. B. Wright 8 Dec. 1965 52 p refs
(NRL-6362; AD-626215) CFSTI: HC $2.00/MF $0.50

A table has been prepared of the functions 1/(1-tan θ) and 1/(1-cot θ) to five significant figures for the range −90° (1°) 90°. One alternative form of these functions is cos θ/cos θ-sin θ) and sin θ/(sin θ-cos θ). A graph of the functions is included. Author (TAB)

N66-20869*# Texas A & M Research Foundation, College Station. Mathematics Dept.
A PICARD ITERATIVE METHOD FOR ESTIMATING SOLUTIONS TO CERTAIN DIFFERENTIAL EQUATIONS
S. A. Sims and M. T. O'Hara [1965] 31 p refs
(Contract NGR-44-001-024)
(NASA-CR-71152) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Numerical implementations of the Picard iteration were utilized to estimate solutions for differential equations through application of a 9 point Lobatto quadrature, with a step size and a given convergence criterion. The same differential equations were also solved by using a fifth order Runge-Kutta

method with several step sizes; the most equivalent solution obtained by the latter method was then compared to the iterative solution. The true answer as well as the estimated answer were computed and compared for each point in the computational routines. Computer trials gave good results when Gaussian quadrature was used to evaluate the truncation integrals for the Lobatto quadrature and conversely. Estimation error tables and values for the 5, 9, and 13 point Gauss and Gauss-Lobatto quadrature are shown. G.G.

N66-20870# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

BOUNDS ON INTERVAL PROBABILITIES FOR RESTRICTED FAMILIES OF DISTRIBUTIONS

R. E. Barlow and A. W. Marshall Sep. 1965 51 p refs *Its* Mathematical Note No. 429

(Contract Nonr-3656(18))

(D1-82-0473; AD-624021) CFSTI: HC $3.00/MF $0.50

For several families of distributions $F(x)=P[X\leq x]$, sharp bounds are obtained on $P[s<X\leq t]$, $P[s<X\leq t \mid X>s]$ and $P[s<X\leq t \mid X\leq t]$. These families are all restricted by a moment condition, and in every case we assume that $P[X<0]=0$. In addition one of the following conditions is imposed: (1) F is concave on $(0,\infty)$, (2) F has an increasing hazard rate, (3) F has a density that is a Pólya frequency function of order 2, (4) F has a decreasing hazard rate, and (5) F has an increasing hazard rate average. Bounds are also obtained on the corresponding densities and hazard rates. Author

N66-20871*# Texas A and M Research Foundation, College Station.

MATRIX METHODS FOR CALCULATING ZEROS, COEFFICIENTS, CHRISTOFFEL NUMBERS, AND DERIVATIVES OF SOME ORTHOGONAL POLYNOMIALS

H. A. Luther and J. M. Nash [1965] 20 p refs

(Grant NGR-44-001-024)

(NASA-CR-71149) CFSTI: HC $1.00/MF $0.50 CSCL 12A

A computational technique is sketched, useful, for example, in the comparative study of various quadrature methods. Inifinite Jacobian matrices are constructed having the property that the eigenvalues of successive leading submatrices are the zeros of successive orthogonal polynomials (or, if desired, their derivatives of any order). Symmetric and unsymmetric formulations are shown. The unsymmetric version proves efficient in finding coefficients for the polynomials. The determinants of leading submatrices of a matrix related to the above can be used to evaluate such polynomials without calculating coefficients. In particular, Christoffel numbers can be so calculated efficiently. The methods apply to any Sturm sequence. Author

N66-20886*# Texas A&M Univ., College Station.

A FIRST ORDER ITERATION PROCESS FOR SIMULTANEOUS EQUATIONS

H. A. Luther and W. F. Stewart [1964] 17 p refs

(Grant NGR-44-001-024)

(NASA-CR-71155) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Presented is a first order iteration process for simultaneous linear or nonlinear equations where the region of influence for a given solution point is the set of all starting values which have that solution point as the limiting value of iteration. The regions of influence are altered rather than the rates of convergence by using first order partial derivatives for converging every solution point whose Jacobian is nonvanishing. An arbitrary function can be used parametrically. A method to accelerate the too slow convergence rate of above described method is also included. G.G.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N66-19806# Joint Publications Research Service, Washington, D. C.

RECENT SOVIET STUDIES IN METEOROLOGY AND HYDROLOGY

4 Feb. 1966 88 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 12, 1965

(JPRS-34005; TT-66-30447) CFSTI: $3.00

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N66-19807 Joint Publications Research Service, Washington, D. C.

TERRITORIAL AND GENERAL METHOD OF FORECASTING RUNOFF: THE BASIS OF HYDROLOGICAL SERVICING OF AGRICULTURE

V. N. Parshin *In its* Recent Soviet Studies in Meteorol. and Hydrol. 4 Feb. 1966 p 1–12 refs (See N66-19806 10-20) CFSTI: $3.00

Several proposals are presented for the improvement of the hydrological servicing of agriculture and the development of methods of forecasting the runoff of rivers is discussed. The basic idea in the proposed method of computation and forecasting of spring runoff is the determination of the general patterns of change of the losses of melt water as a function of the characteristics of the structure of the surface of the watershed and losses on infiltration as a function of the infiltration capacity of the frozen soil. It is noted that the forecasting of spring runoff improves the hydrological servicing of public services, transportation, thermoelectric power stations, and various water economy agencies. E.E.B.

N66-19808 Joint Publications Research Service, Washington, D. C.

CLOUD STRUCTURE IN ATMOSPHERIC VORTICES

N. F. Vel'tishchev *In its* Recent Soviet Studies in Meteorol. and Hydrol. 4 Feb. 1966 p 13–24 refs (See N66-19806 10-20) CFSTI: $3.00

One shortcoming of studies devoted to an explanation of cloud cover spirals is that no allowance is made for the temperature stratification of the atmosphere despite the fact that it exerts an appreciable influence on the formation of wave movements in the atmosphere. The conditions for the existence of wave movements in atmospheric vortices are considered and the interrelationship between the configurations of the cloud bands, temperature stratification of the atmosphere, and the intensity of vortical movement is examined. Using the equations of motion, continuity, state, and heat flux in cylindrical coordinates, computations are presented for determining the region of existence of periodic change of vertical velocity as a function of angular velocity, wave number, and vertical gradient of temperature. Computations of vertical velocity in a cyclone of low intensity and the distribution of vertical velocities in a well-developed cyclone are included. E.E.B.

N66-19809 Joint Publications Research Service, Washington, D. C.

FORECASTING CONTINUOUS PRECIPITATION USING AN ELECTRONIC COMPUTER

A. N. Bagrov *In its* Recent Soviet Studies in Meteorol. and Hydrol. 4 Feb. 1966 p 25–35 refs (See N66-19806 10-20) CFSTI: $3.00

An operational model of forecasting of continuous precipitation is presented which was prepared by mean of an electronic computer. The forecasting of continuous precipitation is based on precomputation of the pressure, vertical currents, temperature, and dew point fields. Operational tests of the mathematical model were made and results are tabulated. A total of 47 maps were computed and the evaluation was made for 20 points in the Soviet Union. The model in general gives a understated quantity of precipitation, especially on fronts by a factor of 2 to 2.5 times. The errors of forecasting precipitation are related primarily to errors in forecasting of the pressure field and vertical movements. E.E.B.

N66-19810 Joint Publications Research Service, Washington, D.C.

THE AMOUNT OF LIGHTNING IN SUMMER IN THE AREA COVERED BY THE CENTRAL ASIATIC THUNDERSTORM DIRECTION—FINDING GROUP

N. I. Leushin and L. N. Ardab'yevskaya *In its* Recent Soviet Studies in Meteorol. and Hydrol. 4 Feb. 1966 p 36–42 refs (See N66-19806 10-20) CFSTI: $3.00

It was previously proposed that thunderstorm activity be characterized by the number of lightning discharges rather than the number of days of thunderstorm activity. Some characteristics of thunderstorm direction finding are summarized since such direction finding was also proposed as the means of determining the number of lightning discharges. A method for determining the number of lightning discharges is reviewed and the method is applied for the compilation of a map of the lightning distribution during the summer season in the area covered by the Central Asian Network. Maps covering the distribution of discharges and of the distribution of the number of days with thunderstorms are presented for the same time period for the same area. E.E.B.

N66-19811 Joint Publications Research Service, Washington, D. C.

SURFACE CIRCULATION PATTERN IN ANTARCTICA

V. Vitek and G. Tarakanov *In its* Recent Soviet Studies in Meteorol. and Hydrol. 4 Feb. 1966 p 43–47 refs (See N66-19806 10-20) CFSTI: $3.00

The general patterns of circulation associated with the heat flux distribution in the south polar regions are examined and the dynamic factors which influence cyclone formation are considered. Also, the surface circulation in Antarctica is described using the relations obtained by Fortak for the nonadiabatic ageostrophic wind component. It is shown that in the transition region from a negative to a positve radiation balance cyclogenesis occurs. For this reason there is a constantly existing circumpolar trough around Antarctica. E.E.B.

N66-19812 Joint Publications Research Service, Washington, D. C.

THE STATISTICAL RELATIONSHIP BETWEEN THE VERTICAL PROFILES OF DIFFERENT METEOROLOGICAL ELEMENTS

A. Turgunov *In its* Recent Soviet Studies in Meteorol. and Hydrol. 4 Feb. 1966 p 48–53 refs (See N66-19806 10-20) CFSTI: $3.00

The development of numerical forecasting methods is discussed and the solution of the problem of forecasting meteorological conditions is examined. Using temperature field expansion, the optimal representations of the vertical geopotential profile is established. Also, the computed vectors of expansion of the geopotential and wind fields are compared with an optimal system of the functions of the wind field obtained from experimental data. The results of such a comparison are shown in the first and second approximations. It is shown that with two parameter representation of these principal fields of the meteorological elements about three-fourths of the dispersion of the temperature field and more than nine-tenths of the dispersion of the geopotential and wind fields can be described. E.E.B.

N66-19813 Joint Publications Research Service, Washington, D. C.

METHODS AND PRINCIPLES OF MODIFICATION OF HAIL CLOUDS (REVIEW OF WORK DONE AT THE HIGH-MOUNTAIN GEOPHYSICAL INSTITUTE)

G. K. Sulakvelidze, N. Sh. Bibilashvili, and V. F. Lapcheva *In its* Recent Soviet Studies in Meteorol. and Hydrol. 4 Feb. 1966 p 54–63 refs (See N66-19806 10-20) CFSTI: $3.00

The investigation of the processes involved in the formation of heavy precipitation and hail is discussed and the methods for forecasting of hail storms are examined. In the forecasting of hail account is taken of the changes of atmospheric stratification and advection of air masses. Also, the melting of hailstones during their falling from the level of the zero isotherm to the earth's surface is considered. The methods for the forecasting of hail phenomena was checked and the success of the methods was extremely high. The prevention of the growth of natural hailstones by introduction of supercooled moisture of certain crystallizing reagents into the zone of accumulation is also discussed. Seven hail modification experiments were carried out which successfully safeguarded an area from hail. In an unprotected area in the same vicinity considerable loss of agriculture crops and damage to industrial objects were experienced. E.E.B.

N66-19818# Joint Publications Research Service, Washington, D. C.
STATISTICAL THEORY OF THE MICROPHYSICAL MECHANISMS OF FORMATION OF PRECIPITATION IN WARM CLOUDS
Hsiu-Chi Chou 8 Mar. 1966 25 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 33, no. 1, Feb. 1963 p 97-108
(JPRS-34460; TT-66-30900) CFSTI: $1.00

This paper gives a preliminary theoretical analysis and report on experimentation on the microphysical mechanisms of the formation of precipitation in warm clouds. The author proposes a theory of stochastic processes of growth of cloud droplets and a model of the microphysical mechanisms of formation of precipitation in warm clouds. The results show that fluctuating phenomena and turbulent coalescence caused by turbulence play an extremely important part in the formation of precipitation. Author

N66-19849# McGill Univ., Montreal (Quebec). Stormy Weather Group.
PRECIPITATION STUDIES BY RADAR AND OTHER TECHNIQUES Final Report, Jan. 1962-Aug. 1965
J. S. Marshall Oct. 1965 14 p refs
(Contract AF 19(628)-249)
(AFCRL-65-845; AD-625888) CFSTI: HC $1.00/MF $0.50

This report covers the study of profiles derived from the stepped grey scale radar maps. The profiles, which are plots of the distribution of area and/or flux of precipitation with intensity as a function of height for a total area of 20,000 sq nmi, give useful data for relation to synoptic meteorology. The results of measurements of snowfall rate by measuring depth increments on the ground by optical attenuation in the falling snow are reported. Author (TAB)

N66-19853# Stanford Research Inst., Menlo Park, Calif.
ATMOSPHERIC WATER VAPOR MEASUREMENTS ON THE GREENLAND ICE CAP Final Report
Elmer Robinson 31 Oct. 1965 49 p refs
(Contract DA-28-043-AMC-00130(E))
(AD-625771) CFSTI: HC $2.00/MF $0.50

Observations of ice cap humidity profiles were made over two periods of approximately one month each during the summers of 1964 and 1965 at Camp Century, Greenland. The Karl Fischer technique used for these observations gives a value of the total water vapor concentration integrated over a sampling period of up to 10 minutes. The accuracy of the system is 2 to 3%. The humidity profiles were obtained from the surface up to a height of 183 ft using the meteorological tower previously erected at Camp Century. Within the sampled layer, the humidity profile showed considerable change both on a day to day basis and on a diurnal cycle during a given day. The humidity profile was apparently tied in quite closely with the radiation balance of the snow surface. During storms and overcast conditions humidity conditions tended to be more uniform both in time and through the sampled layer. During situations with supercooled water fog, conditions tended to be supersaturated with respect to an ice or snow surface but not relative to a water surface. However, the number of fog situations observed were too few to justify any definitive conclusions. Author (TAB)

N66-19865# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
SURVEY OF LITERATURE ON METEOROLOGY AND CLIMATOLOGY [METEOROLOGIE EN KLIMATOLOGIE, LITERATUUR-OVERZICHT]
16 Jan. 1966 26 p refs In DUTCH and ENGLISH *Its* Vol. 12, No. M-134
CFSTI: HC $2.00/MF $0.50

Abstracts and bibliographic notes are presented on the topics of perception methods and instruments, prediction techniques, composition, atmosphere structure, mechanics and thermodynamics, types of weather disturbances, radiation and temperature, atmospheric pressure, horizontal and vertical air currents, and condensation and precipitation.
Transl. by J.O.

N66-19919# Texas A and M Research Foundation, College Station. Dept. of Oceanography.
THE NON-LINEAR RESPONSE OF A TWO-LAYER, BAROCLINIC OCEAN TO A STATIONARY, AXIALLY-SYMMETRIC HURRICANE
James J. O'Brien (Ph.D Thesis) Dec. 1965 12 p refs
(Contract Nonr-2119(04))
(Rept.-65-34T; AD-626809) CFSTI: HC $4.00/MF $0.75

This study is concerned with the theoretical description of upwelling and mixing induced in a stratified, rotating two-layer ocean by momentum transfer from an intense stationary, axially-symmetric atmospheric vortex. A general model is derived which leads to a hierarchy of models of increasing complexity. The mechanisms of energy transfer to and from the atmosphere and to and from the lower layer are examined in detail. Results agree qualitatively with observations taken in the Gulf of Mexico following hurricane Hilda, 1964. Intense upwelling is confined to within twice the radius of maximum winds. The displaced warm central waters produce some downwelling adjacent to the upwelled region. Turbulent mixing of heat and salt modifies the density structure throughout the wind-forced region of the ocean. The degree of upwelling is time-dependent and the hurricane-force winds must act on the ocean for several hours before significant upwelling occurs. In a special model it is shown that the configuration of the upwelled region becomes quasi-stationary when the hurricane-force winds are removed from the system. Author (TAB)

N66-19968# National Science Foundation, Washington, D.C.
WEATHER MODIFICATION Seventh Annual Report, Fiscal Year Ending 30 Jun. 1965
[1966] 121 p refs
(NSF-66-4) GPO: $0.40

Weather modification studies during the year 1965 encompassed a broadly based national program of activities. Emphasis centered on fog dispersion, cloud seeding of moist air masses, suppression of hail, attempts to modify hurricanes, increased precipitation from summer showers and thunderstorms, manipulation of storm tracks, exhausting of fossil fuel gases into the atmosphere, conversion of large rural areas into cities and suburbs, and the injection of jet aircraft exhausts into the atmosphere at jet-stream altitudes. G.G.

N66-20567# France. Direction de la Meteorologie Nationale, Paris.
COLOMB-BECHAR HIGH ALTITUDE WIND STATISTICS, 1959–1964 [VENT EN ALTITUDE A COLOMB-BECHAR STATISTIQUES 1959–1964]
J. Dettwiller Nov. 1965 26 p refs In FRENCH *Its* Monograph No. 51
CFSTI: HC $2.00/MF $0.50

Based on the results of radar measurements, the principle characteristics of high altitude wind and air circulation are delineated, and the parameters for the principle monthly statistics are given. Graphs, tables, and charts are included; and the statistical methods used are described.
Transl. by D.T.

N66-20723# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
WIND CLIMATOLOGY AT KWAJALEIN TEST SITE, KWAJALEIN, MARSHALL ISLANDS
Novella S. Billions 5 Jan. 1966 167 p refs
(RR-TR-66-1; AD-626613) CFSTI: HC $5.00/MF $1.00

This report presents a climatology of upper air wind data at the Kwajalein Test Site. Frequency distributions of scalar winds, zonal and meridional wind components, and wind shears are presented at 1-km altitude intervals for Kwajalein, Marshall Islands. The frequency distributions have been established for the monthly and annual reference periods. The statistical information is based on the observational period January 1956 through October 1963. Author (TAB)

N66-20841# McGill Univ., Montreal (Quebec). Stormy Weather Group.
EXPERIMENTS ON THE NUCLEATION OF ICE 1961–63 Scientific Report No. 7
E. J. Stansbury and Gabor Vali Aug. 1965 28 p refs
(Contract AF 19(628)-249)
(MW-46; AFCRL-65-691; AD-623994) CFSTI: HC $2.00/MF $0.50

Results of recent nucleation experiments with rain-drop-sized samples of distilled water, snow and hail were reported in MW-41 (Vali and Stansbury 1965). In the years 1961–63 similar experiments with less sophisticated equipment produced data on more than 20,000 freezing events. The work of MW-41 indicated that the dependence of freezing temperatures on cooling rate in the earlier experiments was small. The data has therefore been re-examined. For distilled water, the frequency distribution of freezing events with temperature has the shape predicted by the stochastic hypothesis. The mean freezing temperature of drops of distilled water increases by 1 degree when the volume is doubled. The behavior of distilled water during and just following an interval at constant temperature is not predicted correctly by the stochastic hypothesis. For drops of natural precipitation the distributions cannot be described simply in analytical form; water from Alberta hail shows the warmest freezing temperatures, precipitation from Montreal freezes at somewhat colder temperatures. For drops formed from hail, the experiments suggest that the temperature of freezing is related to the specific nucleus content of the drops, and cannot be explained on a stochastic basis alone. Author (TAB)

N66-20865# Naval Observatory, Washington, D. C.
ANNULAR SOLAR ECLIPSE OF 20 MAY 1966
Julena S. Duncombe 6 Aug. 1965 24 p *Its* Circ. No. 109
(AD-626673) CFSTI: HC $1.00/MF $0.50

This Circular contains the following information: The Climatological Data for May; The Eclipse Map from the American Ephemeris and Nautical Almanac; The Path of the Annular Phase; The Central Line, Duration and Width of Path at 10,000 feet, 20,000 feet, 30,000 feet, and 40,000 feet; The Central Line, Duration and Width of Path at 100 km, 200 km, and 300 km; Local Circumstances for Points on the Central Line; Local Circumstances for Geographic Locations for both Annular and Partial Phase; Maps of Portions of the Path, and of the Entire Path. TAB

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-19820# Federal Aviation Agency, Washington, D. C. Systems Research and Development Service.
ELAPSED TIME AS A MEASURE OF NAS TERMINAL PERFORMANCE, FEASIBILITY STUDY, PHILADELPHIA-RICHMOND Interim Report
Donald L. Dunlap and Stanley H. Gaffen Dec. 1965 60 p refs
(RD-65-138)

This study investigates the feasibility of quantifying terminal area delay from the measurement of departure and arrival elapsed times. Elapsed time data were obtained on all fixed wing itinerant flights occurring at Philadelphia International Airport, Philadelphia, Pa., and Byrd Field, Richmond, Va., during a 10 day period in May. The report describes the behavior of the elapsed time data obtained, discusses the use of elapsed time data as a measure of NAS terminal performance, and makes some recommendations regarding the initiation of a national terminal performance measurement system.
Author

N66-20587# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.
NUCLEAR RADIATION AS A GUIDANCE TOOL. PHASE I: SHORT-RANGE ALL-WEATHER FORMATION CONTROL
G. E. Wilcox 13 Dec. 1965 19 p
(NADC-AE-6518; AD-625721) CFSTI: HC $1.00/MF $0.50

Several effective helicopter formation control methods were devised, using a gamma radiation source on the leading craft as a guide beacon. The maximum practical range in 1000 feet, limited only by the strength of source, which could be increased at additional potential hazard to maintenance personnel. The accuracy of signal rises rapidly as the range decreases.

providing an excellent collision-avoidance capability under all-weather day–night conditions. One such device was built into an aircraft-type chassis and will be operated in the dynamic environment of a helicopter for final evaluation.
Author (TAB)

N66-20628 Joint Publications Research Service, Washington, D. C.
A METHOD FOR DETERMINATION OF THE PARAMETERS OF MOTION AND ORIENTATION OF AN OBJECT CLOSE TO A PLANET
G. O. Fridlender and I. G. Ioffe *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, no. 6 11 Mar. 1966 p 244-253 refs (See N66-20606 10-10) CFSTI: $6.00

In (1—2) an astroinertial system for interplanetary flights is investigated and the equations are obtained for describing its operation for the case of motion of an object with respect to the circular orbit along an elliptical meridian. In the given article, an autonomic navigational system is investigated for cosmic flights close to planets of the solar system, and equations of the system are obtained for the general case of motion of the control object in three-dimensional space. The possibility is shown of using this system for control of spatial orientation of an object with respect to its center of mass. Author

N66-20922# Benoix Corp., Teterboro, N. J. Flight Control Lab.
COMMERCIAL INERTIAL NAVIGATION SYSTEM PREDICTED ACCURACY OF THE BANC-461/LN-12 INERTIAL NAVIGATION SYSTEM WHEN INSTALLED IN A DC-8 AIRCRAFT Interim Report
31 Aug. 1965 81 p
(Contract FA-64-WA-5208)
(RD-65-126)

This interim report presents the results of an error analysis study (using a mathematical model) of the BANC 461/LN-12 Inertial Navigation System installed in a DC-8 aircraft. This study was undertaken to describe the theoretical performance of the first automatic autopilot coupled inertial navigation system installed in a commercial jet aircraft engaged in regular passenger service. The DC-8 airframe/autopilot response was approximated by turn coordination dynamics. Tracking performance was predicted using the mathematical model and numerical analysis techniques. Curves of cross-track and along track predicted errors are given for a typical Atlantic crossing leg. Author

N66-21021*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DESCRIPTION OF EXPERIMENTAL OMEGA POSITION LOCATION EQUIPMENT (OPLE)
Charles Laughlin, Gay Hilton, Roger Hollenbaugh, and Richard Lavigne Jan. 1966 45 p refs
(NASA-TM-X-55431; X-731-66-20) CFSTI: HC $2.00/MF $0.50 CSCL 17G

Descriptions of equipment used for the OPLE (Omega Position Location Equipment) experiment are presented. The platform, satellite transponder, platform-to-satellite transmission link, control center, platform deployment, operational system, and Omega system are described. The purpose of the OPLE experiment is to demonstrate the feasibility of using the Omega Navigational System in conjunction with synchronous satellites to establish a global location and data collection system. Possible uses of the OPLE concept are considered (location of various platforms such as oceanographic buoys, commercial aircraft, ocean vessels, animal migration studies, and other uses). An example is given for determining position and velocity on high-speed aircraft. The Omega Navigation System may also be possibly used for locating meteorological platforms. L.S.

N66-21039*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECT OF REDUCED COMPUTER PRECISION ON A MIDCOURSE NAVIGATION AND GUIDANCE SYSTEM USING OPTIMAL FILTERING AND LINEAR PREDICTION
Leonard A. Mc Gee Washington, NASA, Apr. 1966 41 p refs (NASA-TN-D-3382) CFSTI: HC $0.60/MF $0.50 CSCL 17G

Reduced precision was applied to a lunar midcourse navigation and guidance scheme. A program which introduced less precision than the optimum 27 binary bits was used to simulate all or part of the midcourse navigation on a digital computer. The results showed that satisfactory performance of the navigation and guidance scheme can be accomplished at greatly reduced precision in some general areas and with lesser reductions in others provided that the increased errors are properly accounted for. The general areas and corresponding precisions determined are: the precision of the estimated trajectory must be 21 to 27 bits and reference trajectories require 26 or 27 bits, the computations embodied in the optimal filter may be computed with precisions as low as 16 bits and, increasing the precision of the space angle computations over that employed by the weighting matrix was found to produce only a negligible improvement in the estimated state. In addition, the effect of a P matrix which is too conservative an estimator of the errors in the estimated state cause the weighting matrix to give too little weight to space angle information, resulting in very large errors in the estimated state. H.S.W.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-19837 Radio Corp. of America, Princeton, N. J. Astro Electronics Div.
THE SERT CAPSULE—TESTING ION ENGINES IN SPACE
Lawrence E. Golden *In its* Space Electron. [1965] p 46–49 refs Sponsored by NASA (See N66-19827 10-31)

On July 20, 1964, for the first time in history an electric propulsion engine was successfully operated in space. Two complete ion (or electrostatic) engine systems were carried aboard the SERT I capsule launched from Wallops Island, Virginia by a four-stage Scout booster. The flight provided a zero-g time of approximately 48 minutes at an apogee of 2,500 nautical miles. A total of 24 minutes of successful ion propulsion was achieved at a thrust level of about 5 millipounds. The Astro-Electronics Division developed the capsule structure, communications, command capability, power distribution, and stabilization. (NASA had developed, under separate contracts, the ion engine subsystems, the programmer, and the batteries.) Author

N66-19872*# Lockheed-Georgia Co., Dawsonville. Nuclear Labs.
GAMMA SPECTRUM MEASUREMENTS, SNAP 8 RADIATION EFFECTS TEST PROGRAM, VOLUME I
[1965] 22 p refs Prepared for Aerojet-General Corp. (Contract NAS5-417)
(NASA-CR-54386; ER-7448, Vol. I) CFSTI: HC $1.00/MF $0.50 CSCL 18N

The gamma spectra of the Radiation Effects Reactor was measured with three external shield configurations, i.e., 16 inches of lithium hydride, 16 inches of lithium hydride plus 8 inches of water, and 8 inches of water. These masurements were made with a collimated single crystal sodium iodide scintillator (4"×5" diameter). Histogram photon and dose distributions were then computed by means of a 33×33 inversion matrix. These measurements show considerable hardening of the basic reactor spectrum, i.e., the U-235 fission spectrum plus capture gammas from the reactor coolant and structural materials. Data reveals that lithium hydride is not unique in shaping the resultant filtered spectra, but instead demonstrates effects similar to those produced by water. The measured dose distribution shows qualitative agreement with the calculated SNAP-8 environment.
Author

N66-19873*# Lockheed-Georgia Co., Dawsonville. Nuclear Labs.
ELECTRICAL INSULATION MATERIALS, SNAP 8 RADIATION EFFECTS TEST PROGRAM, VOLUME II
[1965] 164 p Prepared for Aerojet-General Corp. (Contract NAS5-417)
(NASA-CR-64387; ER-7644, Vol. II) CFSTI: HC $1.85/MF $1.00 CSCL 18N

Electrical insulation material specimens were encapsulated and exposed to about 10^8 Rads gamma irradiation at 392° ± 3°F in a Radiation Effects Reactor. Evaluated were sheet insulation, wires, fluids, and statorettes. Most specimen showed color changes after irradiation; electrical parameters of all irradiated specimens are shown in tables.
G.G.

N66-19874*# Lockheed-Georgia Co., Dawsonville. Nuclear Labs.
COMPONENTS AND SUB-ASSEMBLIES SNAP 8 RADIATION EFFECTS TEST PROGRAM, VOLUME III
[1965] 340 p Prepared for Aerojet-General Corp. (Contract NAS5-417)
(NASA-CR-54388; ER-7644, Vol. III) CFSTI: HC $3.70/MF $1.75 CSCL 18N

Selected components and operating assemblies underwent irradiation of 2×10^{11} n/cm2 in a controlled heat sink chamber filled with helium. The test program was conducted at 100°F and 160°F in conformance with the design manual; data from both tests indicated no difference due to the temperature variation. Irradiation of diodes destroyed their junction and reduced the semiconductors to intrinsic semiconductor material. Changes in the operational characteristics of all subassemblies were caused by the changes occurring in the semiconductors. Silicon control rectifier components suffered increased forward blocking currents, reverse leakage, and increased firing voltages. Many of the rectifiers did not fire at the end of the test and showed transistor-like operation with very low betas. Resistors and capacitors were not affected by radiation.
G.G.

N66-20059# Israel Program for Scientific Translations, Ltd. Jerusalem.
GAMMA IRRADIATION FACILITIES
A. V. Bibergal', V. I. Sinitsyn, and N. I. Leshchinskii 1965 126 p refs Transl. into ENGLISH of the book "Izotopnye Gamma-Ustandvki" Moscow, Gosatomizdat., 1960 Published for AEC and NSF
CFSTI: HC $4.00/MF $1.00

Problems connected with radiation engineering are considered. Described are the modern calculational methods for gamma irradiators of various configurations. Examples of the calculation of gamma-installation characteristics are given as an aid in design calculations. Other problems discussed are gamma-ray sources and methods of shielding from intense gamma-ray fluxes, information on the measurement of high doses and high dose rates, monitoring and control of powerful gamma-installations, and transportation and loading of irradiators. A bibliography devoted to the problems under consideration is included; references are made to original works which are of interest in design calculations for powerful gamma-installations. Appendices are included as an aid to calculations.
M.R.W.

N66-20135*# Aerojet-General Corp., Azusa, Calif. Rocket Engine Operations-Nuclear.
CONTROL SPECIMEN DATA FOR STRUCTURAL MATERIAL IRRADIATION TEST PROGRAM
12 Nov. 1964 476 p refs
(Contract SNP-1)
(NASA-CR-71020; RN-S-0128) CFSTI: HC $7.76/MF $2.25 CSCL 21F

This report discusses the continuation of a test program to determine radiation effects on structural materials at cryogenic temperatures. The data presented include mechanical properties of tension and shear at cryogenic temperatures (−423°F), and tensile properties at room temperature. Parent metal and welded and brazed specimens of 18 alloys were tested. These metals include aluminum alloys A356, 2219, 5456, 6061, 7075, and 7079; titanium alloy A110-AT; stainless steels 304, 321, 347-C 440C, and AM 350; and high temperature alloys A286, Inconel 713 C, Inconel X-750, H-Monel, Hastelloy C, and TZM molybdenum. The tests were performed to establish reference points for comparison with properties of the same materials after irradiation. After tensile testing, the broken tensile specimens were microscopically examined in the strained and unstrained regions. Optical, electron photomicrographs, and X-ray diffractograms were prepared for future comparison.
R.N.A.

N66-20191# Aktiebolaget Atomenergie, Stockholm (Sweden).
CENTRAL REACTIVITY MEASUREMENTS ON ASSEMBLIES 1 AND 3 OF THE FAST REACTOR FRO
S. O. Londen Jan. 1966 66 p refs
(AE-212) CFSTI: HC $3.00/MF $0.75

The reactivity effects of small samples of various materials have been measured by the period method at the core center of assemblies 1 and 3 of the fast zero power reactor FRO. For some materials the reactivity change as a function of sample size has also been determined experimentally. The core of assembly 1 consisted only of uranium enriched to 20% whereas the core of assembly 3 was diluted with 30% graphite. The results have been compared with calculated values obtained with a second order transport-theoretical perturbation model and using differently shielded cross sections depending upon sample size. Qualitative agreement has generally been found.

although discrepancies still exist. The spectrum perturbation caused by the experimental arrangement has been analyzed and found to be rather important. Author

N66-20200# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).
CALIBRATION SWING MEASUREMENTS IN PTR
A. Okazaki, R. W. Durham, and M. Lounsbury Nov. 1965 29 p refs
(AECL-2506) CFSTI: HC $2.00/MF $0.50

Pile oscillator measurements were made in the PTR reactor on calibration samples of the following aluminum alloys: B–Al, U^{233}–Al, U^{235}–Al, Pu^{239}–Al, B–U^{233}–Al, B–U^{235}–Al. These samples contained a range of fissile material and boron contents which were determined by isotope dilution, alpha counting and chemical methods. The reactivities measured in two neutron spectra were fitted to an empirical expression containing thermal and resonance cross sections. The constants determined are consistent with the cross sections used. Author

N66-20206# Royal Industries, Inc., Pasadena, Calif.
THE CESIUM-137 POWER PROGRAM Final Report, Jan. 1961–Apr. 1963
May 1964 242 p
(Contract AT(04-3)-366)
(SAN-366-1; RRC-0104) CFSTI: HC $3.00/MF $1.50

Activities in a program to design a compact and lightweight thermoelectric generator, power by ^{137}Cs to safely provide uninterrupted power, in the five watt (e) range to an undersea seismic station are described. The ^{137}Cs thermoelectric generator was not capable of delivering 5 w. The other design objectives met during the research are summarized. A chemical fuel form was developed which render radiocesium virtually inert to leaching by either fresh or sea water. Cesium borosilicate formulation process time, temperature requirements, and specialized equipment were developed. An inoperative, full scale model of a Cs generator was fabricated. The model represented a feasible approach to generator design and one which closely resembled the prototype device. A radiation shield was designed, predicated upon the energy levels and relative quantities of gamma and bremsstrahlung radiation anticipated for the radiocesium fuel. Replating the fully fueled (26,000 curies) u core was achieved so that a complete coating of Ni was deposited and the fueled core rendered safe. The overall generator size and weight, although considerably less than existing thermoelectric generators for terrestrial use, came well within the design specifications of 500 lb total weight, and an outside diameter of 13 in. The generator proper was surrounded and contained within a pressure shell which, though light in weight, was capable of withstanding ocean pressures to 36,000 feet depth. A thermoelectric module was developed that provided 2.75 w. A safety analysis was prepared for those credible accidents with which the generator might be involved. Activities in the program have helped to advance the technology of both isotopic power and fission product utilization. Author (NSA)

N66-20217# Oak Ridge National Lab., Tenn.
ATOMIC TRANSPORT PROBLEMS OF INTEREST IN NUCLEAR SYSTEMS
Ted S. Lundy and Fitz R. Winslow [1965] 28 p refs Presented at the Symp. on "Thermodyn. with Emphasis on Nucl. Mater. and Atomic Transport in Solids", Vienna, 22–27 Jul. 1965
(Contract W-7405-ENG-26)
(SM-66/59; ORNL-P-1397); CONF-650704-2) CFSTI: HC $2.00/MF $0.50

Several problems encountered in the application of basic diffusion data to systems of practical interest such as those encountered in nuclear engineering are discussed. These problems include isothermal diffusion experiments, thermal gradient diffusion, and radiation effects on diffusion processes. Recently it was demonstrated that indiscriminate use of an Arrhenius type expression to describe the temperature dependence of diffusion data may lead to large errors in the prediction of diffusion coefficients. The ramifications of this finding are discussed with emphasis on refractory, body centered cubic systems. The effect of a thermal gradient on the redistribution of substitutional impurities in a metal is studied. This work has led to an increased appreciation of the importance of this effect in systems of interest in the nuclear field. The enhancement of diffusion by radiation fields remains a problem of justified interest. Direct measurements of the effect of fast-particle bombardment on diffusion in a metal are reported. Results correlate well with predictions based on a model of the annihilation of excess point defects (vacancies and interstitials) by two mechanisms—migration to homogenously distributed fixed sinks such as dislocations, and recombination of defects. Author (NSA)

N66-20286# Battelle Memorial Inst., Columbus, Ohio.
DEVPLOPMENT OF FABRICATION PROCEDURES FOR THE AARR FUEL PLATES
D. S. Acuncius, D. E. Lozier, D. E. Kizer, and D. L. Keller 1 Feb. 1965 43 p refs
(Contract W-7405-ENG-92)
(BMI-X-327) CFSTI: HC $2.00/MF $0.50

An investigation was conducted of fabrication procedures for a 37 wt % UO_2–stainless steel dispersion clad in stainless steel for use in the Argonne Advanced Research Reactor. Fuel core homogeneity, compaction and sintering, billet preparation, roll bonding, cold rolling, flattening of plates, etc. were studied. Characterization of spheroidal UO_2 particles was also carried out, and suggested fabrication procedures are summarized. NSA

N66-20287# Oak Ridge National Lab., Tenn.
STRESS-RUPTURE TESTING OF EGCR FUEL TUBES
J. T. Venard Jan. 1965 28 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1004) CFSTI: HC $2.00/MF $0.50

Stress-rupture tests have been run on internally pressurized type 304 stainless steel tubes. These specimens were cut from production EGCR fuel-clad tubes after the copper brazing of midplane spacers. Testing was performed at temperatures of 593, 704, 816, and 982° C, which is the expected range of operation of these fuel elements. Results show the strength and ductility properties expected of type 304 stainless steel. There was no loss in strength due to the presence of the copper braze metal or the spacers. No abnormal grain growth occurred during brazing or testing, and results were the same on testing in flowing argon or air atmospheres. Author (NSA)

N66-20303# Commissariat a l'Energie Atomique, Saclay (France). Dept. des Etudes de Piles.
ANALYSIS AND COMPOSITION OF THE FIRST U-Pu CHARGE (0.043% OF Pu) [ANALYSE ET CONSTITUTION DU Ier JEU U-Pu (0.043% DE Pu)]
Jean-Paul Brunet, Dominque De Lapparent, and Pierre Lourme Jan. 1965 51 p refs In FRENCH
(CEA-R-2613)

Checking the homogeneity in the content of plutonium of 0.043% Pu–natural uranium alloy slugs was made by counting ^{240}Pu and ^{238}U spontaneous-fission neutrons. The purpose of the test was to select groups of slugs to be correctly associated into fuel rods for critical experiments. The general technique for spontaneous fissions counting, then elaboration of data in view of ranking the slugs are described. Results are given for this particular case. Author (NSA)

N66-20311# California Univ., Livermore. Lawrence Radiation Lab.
QUALITATIVE EXPERIMENTAL INVESTIGATIONS ON VARIOUS VORTEX TUBE CONFIGURATIONS
J. C. Collins and T. F. Stubbs Aug. 1964 49 p refs
(Contract W-7405-ENG-48)
(UCRL-12045) CFSTI: HC $2.00/MF $0.50

Similarities are considered between the standard vortex tube (upon which most of the past work has been done) and two variations; the tapered vortex-tube and the vortex cooler. It is shown that all three variations contain no fundamental differences, and the variation of tube performance with respect to the setting of the exit gas "hot" valve is explained in terms of compressible flow. Mathematical treatment is kept to a minimum; emphasis is placed upon the experimental results obtained from the tests performed on the variations of the standard vortex tube. Author (NSA)

N66-20312# Oak Ridge National Lab., Tenn.
DEMOUNTING AND MACHINING IN HOT CELLS
E. M. King and J. E. Dismuke 4 Oct. 1964 20 p Presented at the Symp. on Working Methods in High-Activity Hot Labs., Paris
(Contract W-7405-ENG-26)
(ORNL-P-861; CONF-650601-1) CFSTI: HC $1.00/MF $0.50

The types of irradiation experiments which were disassembled and examined in the physical testing hot cells at ORNL are listed together with the tools used. Criteria for choosing tools are given. The ways in which the cutting equipment are used for disassembly are described using an ORR capsule, a fuel plate element, a poolside irradiation box, and a loop experiment as examples. NSA

N66-20346# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science.
THE EFFECTS OF COHERENT SCATTERING ON THE THERMALIZATION OF NEUTRONS IN BERYLLIUM
R. R. Fullwood, E. R. Gaerttner, and R. E. Slovacek [1964] 6 p refs
(Contract AT(30-3)-328)
(RPI-328-22) CFSTI: HC $1.00/MF $0.50

In attempting to study the approach to an asymptotic spectrum in crystalline material, a series of center spectrum measurements on beryllium metal for buckling values of 0.12, 0.075, 0.026, and 0.013/cm^2 and a surface measurement for the buckling 0.026/cm^2 were performed. These measurements were performed using the pulsed-Linac-phased-neutron chopper technique to allow sampling of the neutron spectrum at the desired time. These data cover the range from one mean-lifetime to six for two buckling values. The term mean-lifetime is not uniquely defined in a crystalline material but is taken to be the result of a die-away measurement. NSA

N66-20352# Naval Research Lab., Washington, D. C.
IN-REACTOR FATIGUE TESTS OF A302-B STEEL REPRESENTING THE ELK RIVER REACTOR PRESSURE VESSEL
J. R. Hawthorne and L. E. Steele 15 Feb. 1965 17 p ref
(Contract AT(11-1)-1369)
(NRL-MR-1596) CFSTI: HC $1.00/MF $0.50

Dynamic low cycle fatigue tests of specimens from a 3-inch thick A302B plate representative of the Elk River Reactor (ERR) pressure vessel were performed in-reactor at 550° F. The test apparatus provided for the simultaneous testing of fifteen sheet-type specimens, representing five average strain amplitudes, in reverse bending. The total neutron dosage received by individual specimens at failure ranged from 7.6 to 8.8×10^{18} n/cm^2 (> 1 Mev), as determined from iron and titanium dosimeter wires included in the experiment. The comparison of data derived from in-reactor tests and out-of-reactor control tests performed on duplicate equipment did not reveal an effect of irradiation on fatigue properties. Author (NSA)

N66-20361# Nuclear Materials and Equipment Corp., Apollo, Pa.
GROWTH OF SINGLE CRYSTALS OF PLUTONIUM Quarterly Progress Report, 1 Jan.–31 Mar. 1965
Gary E. Miller, Ivor D. Thomas, and Karl H. Puechl [1965] 9 p refs
(Contract AT(30-1)-2389)
(NUMEC-3428-9) CFSTI: HC $1.00/MF $0.50

Progress is reported in the high pressure studies on α-Pu and strain-anneal studies on δ-Pu. NSA

N66-20382# Chalmers Univ. of Technology, Goteborg (Sweden). Inst. of Physics.
METHODS IN THE PREPARATION OF RADIOACTIVE MATERIALS
W. Parker (Thesis) 1965 92 p refs Submitted for Publication
(NP-15049)

Thirteen papers dealing with the preparation of radioactive samples for use in nuclear research are presented and arranged into four parts. Part I gives a brief description of those methods and techniques most frequently made use of at the present time and also describes the preparation of thin films and foils employed as support material for radioactive layers. Parts II and III, dealing with vacuum deposition and electrodeposition respectively, describe the application of these methods to the preparation of thin layers of radioactive material. In both instances, the highest possible transference or yield, from original form to sample, has been sought. Finally, in Part IV, the results of accumulated procedures are presented for the preparation of seventy elements. Author (NSA)

N66-20405# Los Alamos Scientific Lab., N. Mex.
NEUTRONIC ISOLATION CHARACTERISTICS OF CONCRETE, LEAD, WOOD, POLYETHYLENE AND BERYLLIUM
Thomas C. Mc Creless, Jr. (M.S. Thesis–Md. Univ.) 1965 53 p refs
(Contract W-7405-ENG-36)
(LA-DC-7139) CFSTI: HC $3.00/MF $0.50

Critical approach experiments were conducted to determine the neutron isolating effectiveness of concrete, lead, wood, polyethylene, and beryllium. The Los Alamos Comet assembly machine was used to determine the change in critical thickness of a reference slab of enriched (93.2 wt % ^{235}U) uranium with and without an additional enriched uranium slab beyond an isolator eight inches thick. This change in critical thickness is a measure of the neutron interaction between the uranium units. The isolating abilities of slabs of the selected material eight inches thick are compared to the ability provided by an eight-inch air space. Numerical values for relative isolating ability are obtained for a particular fraction of critical thickness, F, of the additional uranium slab placed beyond the isolator. For F≈0.675, the relative isolating abilities are: polyethylene, 99.6%; lead, 82%; beryllium, 78.7%; concrete, 74%; and plywood, 45.3%. The study provides several other useful results; namely, effectiveness of these materials as reflectors, a tabulation of reflector saving, and the critical thicknesses of inifinte slabs of enriched uranium reflected on one side by eight inches of the isolator and with and without a one-half inch thick steel diaphragm. These thicknesses were determined by electronic computer calculations, using the transport theory code and S_4 approximation.
Author (NSA)

N66-20443# Los Alamos Scientific Lab., N. Mex.
ADVANCED NUCLEAR PROPULSION CONCEPTS
Ralph S. Cooper 1965 38 p refs Presented at the AIAA 2d Ann. Meeting and Tech. Demonstration, San Francisco
(Contract W-7405-ENG-36)
(LA-DC-7118; CONF-650711-2) CFSTI: HC $2.00/MF $0.50

This survey of high thrust nuclear propulsion beyond solid core reactors shows many concepts in the research phase but very few ready for engineering development. Fluidized particle beds offer a modest increase in I_{sp} to about 1100 seconds and the possibilities of high power density and ease of reuse. Liquid core reactors may give up to 1500 seconds, depending upon the fuel vaporization in flowing hydrogen, but are limited to modest thrust by the flow rate of bubbles. Gas core reactors could go to 2500 seconds if the interrelated problems of fluid flow, heat transfer and nuclear criticality could be solved. Heat transfer is usually by radiation which leads to high fuel temperatures (≥20,000°K), and to high pressures (≥200 atm), making any nuclear experiments very difficult. The various concepts differ by the flow patterns designed to reduce the fuel loss rate to acceptable proportions, and include coaxial and vortex flows, and the use of magnetohydrodynamic effects. The closed pulse system requires large thrust chamber mass and several thousand pulses of very low yield. The open pulse system (Orion) seems technically feasible at 2500 seconds but needs a nuclear ablation test for confirmation and its eventual use is clouded by political considerations.
Author (NSA)

N66-20456# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
PRECON—A FORTRAN IV PROGRAM FOR COMPUTING CONTAINMENT PRESSURE
R. H. Hansen 31 Mar. 1965 53 p refs
(Contract AT(04-3)-167)
(GAMD-6276) CFSTI: HC $3.00/MF $0.75

PRECON, a FORTRAN IV program for the IBM 7044 computer, determines the containment pressure in a high-temperature gas-cooled reactor system as a function of time after rupture in the primary system or stream generator. The maximum containment pressure calculated in this way can be used to establish the containment vessel design pressure. The calculation procedure and a sample problem are described.
NSA

N66-20477# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
FABRICATION OF MIXED URANIUM AND PLUTONIUM OXIDE PELLETS [FABRICATION DE PASTILLES D'OXYDES MIXTES D'URANIUM ET DE PLUTONIUM]
Guy Dean, Camille Pelou, and Desire Beugnies Jan. 1965 40 p refs In FRENCH
(CEA-R-2737)

Results of sintering of UO_2–PuO_2 solid solutions are presented. Two processes are described: the first one is the standard process involving mechanically mixed oxides PuO_2 and sinterable UO_2, whereas in the second one, direct mixtures of UO_3 or U_3O_8 and PuO_2 are pressed and sintered. For the two processes, sintering is carried out in flowing pure or dilute hydrogen at a temperature of 1650°C during four hours. In both cases, the $(U,Pu)O_2$ pellets have the same general characteristics (PuO_2≈20 percent): a bulk density between 98 and 99 percent of the theoretical density, a single phase product with grains of about 10 to 20 μ, and an oxygen-to-metal ratio varying between 2.00 and 1.95 according to the moisture content of the sintering atmosphere.
Author (NSA)

N66-20478# Oak Ridge National Lab., Tenn.
FABRICATION VARIABLES, PERFORMANCE, AND COST CONSIDERATIONS FOR HTGR COATED-PARTICLE FUELS
W. O. Harms and D. B. Trauger 30 Apr. 1965 31 p refs Presented at EURATOM Symp. on Fuel Cycles of High-Temp. Gas-cooled Reactors, Brussels, 10–11 Jun. 1965
(Contract W-7405-ENG-26)
(CONF-650606-5; ORNL-TM-1123) CFSTI: HC $2.00/MF $0.50

Studies involving the development of pyrolytic-carbon-coated uranium–thorium carbide particles and of graphite–matrix fuels containing coated particles have produced a basis for HTGR fuel element designs and for fuel-cycle cost analysis. Irradiation tests combined with thermal and mechanical test evaluations have demonstrated satisfactory fuel element performance for pebble-bed reactor application. More recent work on particle coating and evaluation techniques has led to means for improved control of production variables. Pyrolytic-carbon-coated oxide fuel particles offer promise for reduced costs and satisfactory reactor service. The results presented are generally applicable to prismatic fuel structures as well as to spheres.
Author (NSA)

N66-20479# European Atomic Energy Community, Brussels (Belgium).
FABRICATION OF ECO URANIUM CARBIDE FUEL ELEMENTS [FABRICATION DES ELEMENTS COMBUSTIBLES ECO EN CARBURE D'URANIUM]
J. Briola and U. Heubner 1965 64 p ref In FRENCH
(EUR-2214.f)

A description is given of the fabrication of the two first sets of aluminum-sheathed uranium carbide fuel elements for the ECO reactor (ORGEL critical experiment). The first set consists of 25 seven-rod clusters (pellet diameter=25.2 mm; fuel length=2,900 mm). The second set consists of 25 matrix-type four-rod clusters (pellet diameter=30.9 mm; fuel length=2,900 mm). Author (NSA)

N66-20481# Battelle Memorial Inst., Columbus, Ohio.
FISSION-PRODUCT REACTIONS WITH AND RELEASE FROM FUEL-ELEMENT CLADDINGS Quarterly Progress Report, Jan.–Mar. 1965
Duane N. Sunderman, David L. Morrison, James E. Howes, Jr., and Edward J. Jablonowski 1 Apr. 1965 7 p
(Contract W-7405-ENG-92)
(BMI-X-10118; EURAEC-1364) CFSTI: HC $1.00/MF $0.50

Progress is reported in the measurement of the diffusion coefficients of nongaseous fission products in fuel element cladding materials. Diffusion coefficients were measured for Zr and Te in Zr at 650 and 750°C. A uniform distribution of Ru in Zr was obtained over the diffusion range studied. (NSA)

N66-20482# Sandia Corp., Albuquerque, N. Mex.
REENTRY FLIGHT DEMONSTRATION NUMBER TWO Final Report
8 Apr. 1965 264 p refs
(Contract AT(29-1)-789)
(SC-RR-65-43) CFSTI: HC $6.00/MF $1.75

RFD-2 was the second of Sandia's operational safety flight tests of systems for nuclear auxiliary power. The flight, conducted on October 9, 1964, was highly successful, with essentially all of the test objectives being met. This report describes the RFD-2 re-entry system and the instrumentation used to cover the flight, presents the data obtained, and gives an evaluation of the results of this test. Author (NSA)

N66-20486# Los Alamos Scientific Lab., N. Mex.
NRDS ANALYSIS OF THE KIWI B-4D-202 NUCLEAR REACTOR CONTROL SYSTEM
Thomas O. Hearn 20 Sep. 1965 103 p refs
(Contract W-7405-ENG-36)
(LA-3301-MS) CFSTI: HC $4.00/MF $0.75

The technique used in controlling nuclear rocket engines at NRDS is summarized. The control systems used with the KIWI B-4D-202 reactor series are evaluated through the use of an analog computer simulation. The three modes of control discussed are: automatic reactor startup, power control, and power-temperature control. A brief analysis of the B-4E-301 temperature control system is also included. Author (NSA)

N66-20508# Norwegian Defence Research Establishment, Kjeller.
PARTICULATE NUCLEAR BOMB DEBRIS AS A METEOROLOGICAL TRACER
P. B. Storeboe Mar. 1965 92 p refs Presented at 4th Symp. on Radioactivity in Scandinavia, Risoe, Denmark, Oct. 1964
(NDRE-51; CONF-747-6)

The suitability of particulate nuclear bomb debris as tracer material in meteorlogical research was investigated. Particle size is a very important parameter, and much emphasis was laid on an attempt to assess the size through inference from direct and indirect observations, as well as through computations. Even for air bursts, a significant part of the debris may be in the micron range at the moment of cloud stabilization. Sources of systematic and unsystematic errors during sampling are discussed. It is pointed out how representativity and reasonable sampling procedures vary with the problem under study, and a number of pure debris effects are indicated. Potentialities and limitations of particulate nuclear bomb debris as meteorological tracer material are then discussed in connection with a critical survey over applications made in the past. It is especially difficult to carry through long-time studies by help of the debris.
Author (NSA)

N66-20509# Chalmers Univ. of Technology, Goteborg (Sweden).
THE NON-DESTRUCTIVE ANALYSIS OF IRRADIATED FUEL ELEMENTS Final Report, Apr. 1965
Nils Ryde 10 May 1965 47 p refs
(NP-15344)

Methods used for the nondestructive burnup analysis of irradiated reactor fuel elements are reviewed. A procedure that uses a bent crystal spectrometer to measure the gamma lines from fission products and relate the intensity to the amount of burnup is described. The design of the spectrometer is given.
NSA

N66-20552# Commissariat a l'Energie Atomique, Saclay (France). Centre D'Etudes Nucleaires.
FLUX AND TEMPERATURE DISTRIBUTION IN THE NUCLEAR THERMIONIC CONVERTERS SIRENE 50 AND SIRENE 100 [REPARTITION DES FLUX ET DES TEMPERATURES DANS LES CONVERTISSEURS THERMOIONIQUES NUCLEAIRES SIRENE 50 ET SIRENE 100]
Jean Bliaux and Jean-Michel Jamet May 1965 55 p refs In FRENCH
(CEA-R-2782)

A preliminary calculation concerning the perturbed neutron flux in a nuclear thermionic converter is given; the true flux value makes is possible to check the real conversion efficiency. Then, another calculation to determine the temperatures distribution in the fuel pin is presented (assuming several conditions about the neutron flux repartition). A comparative neutronical and thermal study makes it possible to judge the interest of an annular fuel pin converter. Author (NSA)

N66-20556# Oak Ridge National Lab., Tenn.
NEUTRON RESONANCE STRUCTURE AND S-WAVE STRENGTH FUNCTION OF THE EVEN ISOTOPES OF ZIRCONIUM
J. A. Biggerstaff, W. M. Good, and H. J. Kim [1964] 4 p refs Presented at the Intern. Conf. on the Study of Nucl. Struct. with Neutrons, Antwerp
(Contract W-7405-ENG-26)
(ORNL-P-1346; CONF-650706-7) CFSTI: HC $1.00/MF $0.50

In order to furnish more detail on the role of magic number so far as strength function is concerned, the total cross sections of the even isotopes of zirconium are presented. Preliminary results were previously reported and the present results represent extension of the measurements to 60 keV with thicker samples. The samples consisted of at most 12 grams at about 80% purity in the case of ^{90}Zr and at most 50 grams of better than 95% purity in the cases of $^{90,92,94}Zr$. All samples were in the form of oxides. NSA

N66-20560# Atomics International, Canoga Park, Calif.
NONDESTRUCTIVE DETERMINATION OF U^{235} CONTENT OF SNAP FUEL RODS. VOLUME III: EQUIPMENT DESCRIPTION AND PRODUCTION QUALITY CONTROL APPLICATIONS
A. R. Mooers and R. C. Barry 15 May 1965 28 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9600, Vol. 3) CFSTI: HC $2.00/MF $0.50

An autoradiometric test method and associated production inspection equipment have been developed for nondestructively measuring the incremental and total ^{235}U content in cylindrical SNAP fuel rods. The determination is accomplished by measuring the intensity of the 185 keV gamma photo peak from ^{235}U and comparing this value with a reference standard of known composition. A prototype single-channel analyzer scintillation counting system and special fuel rod scanning mechanism are described. A statistical evaluation of the autoradiometric and destructive chemical methods disclosed a correlation coefficient between the two methods to be 0.976. The precision of the autoradiometric method was 0.023 wt % uranium when the test samples were fully enriched 10% U–Zr SNAP fuel rods.

Author (NSA)

N66-20913# European Atomic Energy Community, Brussels (Belgium).

NEUTRON TRANSPORT IN A SPHERICAL REACTOR, A STUDY IN THE APPLICATION OF THE j_N APPROXIMATION OF THE MULTIPLE COLLISION METHOD

T. Asaoka Jan. 1966 37 p refs

(EUR 2627.e) CFSTI: HC $2.00/MF $0.50

The j_N approximation to the solution of neutron transport problems has emerged in the course of developing the multiple collision method, which is based on the random walk approach. By means of this new method, transport problems for a multiregion spherical reactor, where the total neutron cross-sections are independent of the spatial region (position), are treated in the context of a multigroup model under the assumption that the scattering of neutrons is spherically symmetric in the L system. The critical radii for bare spheres, calculated by using the j_N approximation in combination with a one-group model, are compared with those obtained from the S_N method and the exact values. In order to give a numerical illustration of the multigroup model, calculations are performed on two fast neutron critical assemblies, Godiva and Jezebel, and the results are compared with those of the S_4 approximation and experiment.

Author

N66-20916# European Atomic Energy Community, Brussels (Belgium).

A ONE-GROUP COLLISION PROBABILITY CODE FOR CYLINDERS AND SLABS

B. Quiquemelle Jan. 1966 43 p refs

(EUR-2624.e) CFSTI: HC $2.00/MF $0.50

The Code TIJ performs the numerical evaluation of the collision probabilities in concentric cylinders or slabs. For cell calculations several boundary conditions can be imposed including a black inner region. Escape probabilities and Dancoff coefficients calculations are compared with other methods. The complete list of the FORTRAN programme is given.

Author

N66-20977# United Kingdom Atomic Energy Authority, Risley (England).

ECONOMICS OF ALTERNATIVE NUCLEAR POWER PROGRAMMES BASED ON GAS-COOLED GRAPHITE AND FAST REACTORS

C. E. Iliffe 1965 56 p refs Reissued

(TRG-1115(R)) HMSO: 8s

The DISCOUNT computer program has been used to evaluate discounted unit costs and minimum plutonium selling prices for various alternative nuclear power programs. The build-up of plutonium stocks and the installed capacity of different reactor types, with their load factors, is also given for Magnox, Large Magnox, A.G.R. and the Fast Reactor. The lowest discounted unit cost is obtained when the 5000 MW(E) Magnox program is followed by A.G.R. and carbide-fueled fast reactors. If nuclear power expands only to take up the base load, this lowest cost is 0-465 d/u.s.o. If all conventional stations are ultimately replaced by nuclear ones, the cost is 0-509 d/u.s.o. These costs increase by 0-021 and 0-015 d/u.s.o. respectively when the carbide fuel at 5% burn-up is replaced by a 60% stainless steel/oxide cermet at 10% burn-up. Minimum selling prices for plutonium are determined for each nuclear power program for various quantities of plutonium sold. The effects on these prices of reactor capital costs, order of load factor, and interest rate are also considered.

Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N66-19804# Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD MAY–AUGUST 1965 [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE MAGGIO–AGOSTO 1965]

10 Sep. 1965 84 p In ITALIAN; ENGLISH summary Synopsis of the Lectures held at the Phys. Lab. of the Ist. Super. Di Sanita, May–Aug. 1965

(ISS-65/29) CFSTI: HC $3.00/MF $0.75

Abstracts of lectures held at the Physics Laboratory from May to August 1965 are presented. Included among the abstracts are: (1) The Effect of Oligonucleotides on the Activity of Tumor DNA Polymerase. (2) The Mossbauer Effect in the Rare Gases and Inclusion Compounds. (3) Luminescence and Photoconductivity in Silver Halides.

R.R.D.

N66-19866# General Electric Co., Philadelphia, Pa.

OZONE, NITRIC OXIDE, AND RADIATION EFFECTS ON A SUPERSONIC TRANSPORT Final Report

A. F. Petty, I. Jurkevich, and S. P. Shen Aug. 1963 197 p refs (Contract FA-WA-4181)

A study of the effects of ozone, oxides of nitrogen, radiation, and other phenomena associated with high altitude flying has been conducted in an assessment of possible potential hazards to the safe operation and design of a supersonic transport. Effects on the passengers and crew as well as the structural design have been considered in the light of existing knowledge. This report is divided into three sections, the first being devoted to ozone and the oxides of nitrogen. The second section considers the natural radiation background while the third section is concerned with nuclear bomb debris and the natural aerosol component of the upper atmosphere. Each section is complete within itself, offering a summary of the important aspects of the problem as well as specific conclusions and recommendations for future action.

Author

N66-19901*# Arizona Univ., Tucson. Field Emission and Space Systems Lab.
DETECTION TECHNIQUES FOR TENUOUS PLANETARY ATMOSPHERES Fifth Six-month Report, 1 Jul.-30 Dec. 1965
Sturat A. Hoenig and Jay Abramowitz [1966] 211 p refs (Grant NsG-458)
(NASA-CR-70934) CFSTI: HC $6.00/MF $1.25 CSCL 07D

CONTENTS:

1. DETECTION TECHNIQUES FOR TENUOUS PLANETARY ATMOSPHERES Stuart A. Hoenig and Jay Abramowitz 30 p refs
2. CHANGE IN THE THERMIONIC EMISSION CURRENT OF PALLADIUM DUE TO CHEMISORPTION OF ATOMIC AND MOLECULAR HYDROGEN M. M. Eisenstadt 165 p refs (See N66-19902 10-06)

N66-19945# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum.
RESEARCH OF THE DETERMINATION BOUNDARY BY MEASUREMENT OF RADIOACTIVE MATERIALS [ERMITTLUNG DER ERFASSUNGSGRENZE BEI MESSUNGEN RADIOAKTIVER STOFFE]
Christo Kambourov 1965 23 p refs In GERMAN Submitted for Publication Sponsored by Intern. Atomic Energy Comm. (SGAE-SS-2/1965) CFSTI: HC $1.00/MF $0.50

A formulation for the minimal detection limit of a true pulse rate radiation counter was developed from its no-load values and the overall measurement time by statistical methods. The overall impulse effect was determined by the formula

$$\gamma = \frac{K^2 + 2K\sigma\sqrt{\nu^0 Tm}}{\sigma^2 Tm}$$

where ν_0 is the impulse rate for the zero effect, σ the degree of accuracy, K the reliability limit, and Tm the time in minutes. An example calculation for a detector efficiency with reliability limit of 95% was performed. Transl. by G.G.

N66-20009# Naval Training Device Center, Port Washington, N. Y. Electronics Lab.
AN EXPLORATORY INVESTIGATION INTO THE POLARITY STABILITY OF THE ELECTROSTATIC CHARGE ON AN IN-FLIGHT PROJECTILE
Morris L. Groder Jul. 1965 40 p refs
(NAVTRADEVCEN-IH-30; AD-626189) CFSTI: HC $2.00/MF $0.50

The paper describes exploratory experiments performed to determine the effects of gun barrel temperature on the stability of an in-flight bullet's natural electrostatic charge. The data derived from these exploratory experiments indicate that (1) there is a correlation between the polarity (negative-positive-zero) stability of the projectile's electrostatic charge and the thermal inertia effects in the rifle; (2) discrete mobile signal phenomena exist as a function of the thermal conditions in the launcher; and (3) it is possible to predict and/or control specified characteristics of the electrostatic charge on an in-flight projectile. Author (TAB)

N66-20036*# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
PRINCIPLES OF GENERAL COVARIANCE IN ITS VARIOUS FORMULATIONS AND THE RELATED PROBLEMS OF THE ROLE OF COORDINATES IN GENERAL RELATIVITY Final Report
James L. Anderson Jun. 1965 41 p refs
(Grant NsG-326-63)
(NASA-CR-70941; SIT-P149(8165)) CFSTI: HC $2.00/MF $0.50 CSCL 20J

The general problem of how large a set of covariance conditions can be imposed on a theory with a covariance group is discussed. In imposing such conditions the natural requirement is made that such conditions must be satisfiable by at least one member of every equivalence class of physically distinct solutions. Even so it is shown in the cases of electrodynamics and relativity theory that a number of conditions can be imposed sufficient to reduce the covariance group down to the identity. As a consequence it is concluded that the Kretschman definition of the Relativity group of a theory is not a useful definition since it always leads to the Relativity group being the identity group. Author

N66-20069 Technical Univ. of Istanbul (Turkey).
ON A PROJECTIVE TRANSFORMATION BOUND TO A SPHERICAL PROJECTION [SUR UNE TRANSFORMATION PROJECTIVE LIEE A LA PROJECTION SPHERIQUE]
Suat Akin *In its* Bull. of the Tech. Univ. of Istanbul 1965 p 59-77 In FRENCH (See N66-20068 10-34) CFSTI: HC $4.00/MF $0.75

Given that a projective transformation in Euclidean space is defined by a biunivical correspondence between a point and a section of the plane of projection of a sphere tangent to that plane, the following are demonstrated: (1) A conic section of the plane of projection tangent to a perpendicular corresponds to each perpendicular of the space and to each perpendicular symmetrical to a plane of symmetry characterized by the transformation. (2) A circle bitangent to this conic section corresponds to two points symmetrical to the pair of perpendiculars. (3) Circles bitangent to a conic section of the plane of projection correspond to the points of a conic section symmetrical to the plane of symmetry. Transl. by D.T.

N66-20106# Illinois Univ., Urbana. Biological Computer Lab.
A TECHNIQUE FOR THE ANALYSIS OF MUSICAL INSTRUMENT TONES Technical Report No. 6
Morris David Freedman Oct. 1965 146 p refs
(Grants PHS-GM-10718-03; AF-AFOSR-7-64)
(AFOSR-65-2293; AD-627181) CFSTI: HC $4.00/MF $1.00

A technique to analyze the transient part of a musical tone was developed. The analysis was carried out on Illiac II, a high-speed digital computer, the signals being presented to the computer through an analog digital converter. The analysis procedure consists of four steps: (1) The determination of an adequate mathematical specification for an equation which will represent the sound pressure wave generated by an instrument; (2) the determination of the constants in the equation for a given tone. (No assumption is made regarding the frequencies of the partial tones. Inharmonic partials are detected and accounted for in the specification function); (3) the verification of the results, both mathematically and by resynthesis of the tone (using Illiac II) to check the adequacy of the representation (The former technique yields a more sensitive measure of error.); (4) iterating, if necessary, to improve the results. At this stage, the original specification function may be altered, if necessary. A great deal of success was obtained with this scheme and resynthesis has proven to be quite successful. Author (TAB)

N66-20119# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
IMPROVEMENT OF METHODS FOR MEASURING DETONATION RATES
F. M. Galadzhii, V. N. Zenin, and B. I. Vainshtein 23 Nov. 1965 7 p refs Transl. into ENGLISH from Vzryvnoe Delo. Prom. Vzrychatye Vesachestva, Sb., No. 52/9, 1963 p 108–114
(Contract NOw-62-0604-c)
(TG-230T461; AD-625605) CFSTI: HC $1.00/MF $0.50

Special resistance meters, developed to measure continuously the detonation rate when optical methods cannot be used, are described. Details are also given on an electronic circuit, and the selection of the circuit parameters for obtaining time-constant and sufficiently high current when the circuit resistance varies. The meter voltage variations are recorded by the OK-17M oscillograph. A second method employs a modification to the IV-13M oscillograph to increase range. This was accomplished by adding an ionization counter pulse transformer to the circuit; modifications to the circuit are also discussed. N.E.N.

N66-20133*# Optics Technology, Inc., Palo Alto, Calif.
FIBER OPTICS COMPONENT STUDY Final Report
N. S. Kapany, D. F. Capellaro, B. G. Phillips Jan. 1966 82 p ref Prepared for JPL
(Contract NAS7-100; JPL-950612)
(NASA-CR-70928) CFSTI: HC $3.00/MF $0.75 CSCL 20F

Vignetting design data on lens-Focon and lens-field flattener systems were generated. Several experimental Focons and field flattener systems were constructed and their performances were compared with those predicted from the theoretical criteria. In general, satisfactory correlation of the predicted and actual performance was achieved. The Focon fabrication process which was developed in the course of the contract is described in some detail. The resulting Focons were evaluated in terms of line spread function, MTF, vignetting and T/No. Very little effort was expended in improving the already adequate technique used in fabricating field flatteners. However, the effect of applying an absorbing dye to the outer coating of the individual fibers was investigated. The results indicated an improvement of the wide-angle performance of the field flattener. Fresnelization techniques were not developed in the course of the contract but experimental data on Fresnel lenses were collated and they confirmed the considerable improvement in wide-angle performance which could be attained by means of Fresnelization. Author

N66-20146# Physics Lab. RVO TNO, The Hague (Netherlands).
THE BASIC CHARACTERISTICS OF IMAGE INTENSIFIERS [DE FUNDAMENTELE GROOTHEDEN VAN DE HELDERHEIDSVERSTERKER]
H. J. Dirksen Sep. 1965 35 p In DUTCH; ENGLISH summary
(PHL-1965-35; TDCK-44327) CFSTI: HC $2.00/MF $0.50

The concept of image and object elements along with the transfer functions method is used to describe image quality and transfer in image intensifiers. The image and object elements are equated using the basic characteristics for night viewers which are the magnification, the general luminance gain, and the contrast transfer. The relation between the contrast transfer, the amplitude transfer function, and the spread function is indicated. An expression for the recognition distance of different targets, for different atmospheric conditions, is derived. E.A.O.

N66-20155# Office of Naval Intelligence, Washington, D. C. Translation Section.
CORRELATION METHOD OF MEASURING ROLLING SPEED. OTHER EXAMPLES OF USE OF THE CORRELATION METHOD FOR MEASURING SPEEDS [KORRELYATSIONNYY METHOD IZMERENIYA SKOROSTI DVIZHENIYA. DRUGIYE PRIMERY PRIMENENIYA KORRELVATSIONNOGO METODA IYMERENIYA SKOROSTU]
S. F. Kozubovskiy [1965] 38 p refs Transl. into ENGLISH from the book "Avtomaticheskiye Korrelyatsionnyye Izmeriteli Skorosti" Kiev, Akad. Nauk Ukr. SSR, 1963 p 7–11, 57–79
(ONI-1096; AD-627247) CFSTI: HC $2.00/MF $0.50

Translations are given for part 2 of Chapter 1 and for Chapter 5. CORRELATION METHOD OF MEASURING ROLLING SPEED: The method of the British Iron and Steel Research Association (BISRA) is regarded as more promising than the method of magnetic sparks. The BISRA method uses light strokes with their axes perpendicular to the direction of movement of the steel bar. The strokes are projected via an optical system on a moving metallic surface. OTHER EXAMPLES OF USE OF THE CORRELATIONAL METHOD FOR MEASURING SPEEDS: BISRA automatic correlational meter for measuring rolling mill speeds; correlational speed measuring devices for aircraft and for cosmic craft (including their radio navigational installations); correlating speed measuring device for river craft; other examples of the correlation method of speed measurement. TAB

N66-20184# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE INFLUENCE OF EROSIVE BURNING ON ACOUSTIC INSTABILITY IN SOLID PROPELLANT ROCKET MOTORS
R. W. Hart, J. F. Bird, and F. T. Mc Clure Apr. 1960 37 p refs
(Contract NOrd-7386)
(TG-335-6; AD-626739) CFSTI: HC $2.00/MF $0.50

The influence of erosivity on the acoustic stability of solid fuel rockets is examined. Allowance is made for a frequency-dependent erosion constant. The theory verifies the stabilizing influence of the steady flow erosivity for propellants having positive erosion constants, with the contrary prediction for those having negative erosion constants. The influence of acoustic erosion is examined and the order in which it contributes is shown to depend on the symmetry of the flow field in the rocket, being quite different for rockets with nozzles at the end as compared to rockets with nozzles in the center. Degenerate and quasi-degenerate cases where erosivity might become a predominant effect are discussed. Author (TAB)

N66-20227# California Univ., Livermore. Lawrence Radiation Lab.
HYDRODYNAMIC CALCULATIONS OF GENERAL RELATIVISTIC COLLAPSE
Michael M. May and Richard H. White 7 Jun. 1965 40 p refs
(Contract W-7405-ENG-48)
(UCRL-14242) CFSTI: HC $2.00/MF $0.50

The general relativistic equations governing the motion of a large mass under the influence of its own gravitational field and its own pressure are approximated by finite difference equations. A spherically symmetric, co-moving frame of reference is used. The pressure is assumed to be zero at the outer boundary. Rest mass is assumed to be conserved, and heat transfer by neutrinos, radiation, etc., is not taken into account. Numerical solutions were obtained on a computer for several simplified equations of state, chosen to bracket the behavior of stellar material in late stages of collapse, and several masses. The maximum stable masses obtained

are of the same order of magnitude as, but somewhat larger than, the maximum stable masses calculated statically. Estimates of the amount of mass which can be thrown off are made. The behavior of light signals, metric coefficients, and hydrodynamic quantities as functions of time is described for a case of collapse continued past the Schwarzchild radius.
Author (NSA)

N66-20236# Sandia Corp., Albuquerque, N. Mex.
PRESSURE DISTRIBUTIONS ON SPHERE CONES
D. M. Ellett Jan. 1965 52 p refs
(Contract AT(29-1)-789)
(SC-RR-64-1796) CFSTI: HC $3.00/MF $0.75

Except for the information contained in a Russian publication, little pressure distribution data on sphere cones have been found in the open literature. In the present study, the results of the Russian calculations have been transformed to the units used widely in this country, then they have been tabulated and plotted, both (1) as a pressure ratio of the local static cone pressure to the stagnation point pressure versus the normalized surface distance (p_c/p_{T_2} versus S/R) and (2) as a coefficient of pressure versus the normalized surface distance (C_p versus S/R). These pressure distributions are calculated for cone angles of 0, 5, 10, 20, 30, and 40 degrees and for Mach numbers of 3, 4, 6, 10, and infinity. The cone angle is defined as the angle between the cone surface and the axis of symmetry of the cone.
Author (NSA)

N66-20267# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
MATHEMATICAL MODELS OF DIFFUSION IN GRAIN BOUNDARIES
Lida K. Barrett [1964] 11 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1224) CFSTI: HC $1.00/MF $0.50

The mathematical models by Fisher, Whipple, and Suzuoka for diffusion in grain boundaries are given in such a way that their derivations, physical assumptions, mathematical statements, and manners of solution can be readily compared. A summary is given of the results contained in various commentary and comparison papers, including a summary of the facts that can be of use in the interpretation of experimental results.
Author (NSA)

N66-20272# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
A SOLUTION TO ELECTROMAGNETIC INDUCTION PROBLEMS
Caius Vernon Dodd (M.S. Thesis—Tenn. Univ.) Aug. 1965 31 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1185) CFSTI: HC $2.00/MF $0.50

A technique is described for solving electromagnetic induction problems. The differential equation for the vector potential is derived from Maxwell's equations. The various terms in the differential equation are approximated by finite difference equations, yielding an equation for the vector potential at a point in terms of the vector potential at surrounding points. By a relaxation technique, the vector potential for any axially symmetric induction problem can be calculated. Once this vector potential is known, any physically observable electromagnetic phenomenon, such as induced current, induction heating density, and coil impedance, can be calculated. These phenomena are calculated. Curves of calculated coil impedance agree with measured coil impedance.
Author (NSA)

N66-20336# Sydney Univ. (Australia). Wills Plasma Physics Dept.
EXPERIMENTAL STUDIES OF J×B IONIZING FRONTS PROPAGATION OVER THE PRESSURE RANGE 10 TO 800 MILLITORR
D. D. Millar and C. N. Watson-Munro Aug. 1965 18 p ref
(NP-15570; ER-16)

Experimental results of the properties of J×B ionizing fronts over the pressure range 10 to 800 millitorr of hydrogen are presented. It is concluded that the fractional ionization (which in our case ranged from close to unity down to 0.15 at the higher pressures) plays an important role in determining the azimuthal and front velocities. The results of experiments designed to collide two fronts rotating in opposite directions are also reported.
Author (NSA)

N66-20342 Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany).
THE DETERMINATION OF PENETRATION OF AEROSOLS IN FILTERS [DIE BESTIMMUNG DER EINDRINGTIEFE VON AEROSOLEN IN FILTERN]
Volkhard Lossner Apr. 1965 35 p refs In GERMAN; ENGLISH summary
(SZS-2(1965))

A procedure for the determination of the depth of penetration of a radioactive marked monodisperse aerosol in membrane and fiber filters is given. On a largely monodisperse SiO_2 aerosol of 0.55 μ, secondary products of thoron were deposited. This aerosol was deposited in membrane and fiber filters. The residual range of the alpha rays from the ThC' which was emitted from the filter surface was determined. Under certain conditions, the measured curves for the number of alpha particles, when subjected to graphical differentiation, yield a picture of the depth of penetration of the aerosol. On the basis of the results obtained with membrane and fiber filters, three different forms of the deposition can be derived. Two of them can be explained by the filtration theory (experimental law for filtration). For the third, a possible explanation is given. It is shown that the differential equation for filtration has no general validity. The aerosol, its size distribution, its radioactive tagging, its deposition in the filter, the measuring process, and the measuring chamber are described.
Author (NSA)

N66-20365# Stanford Research Inst., Menlo Park, Calif.
SORPTION OF GASES ON METAL SURFACES IN ULTRA-HIGH VACUUM Quarterly Progress Report No. 10, 15 Feb.–15 May 1965
B. Bergsnov-Hansen, N. Endow, and R. A. Pasternak 21 May 1965 12 p
(Contract AT(04-3)-425)
(SRIA-425-5) CFSTI: HC $1.00/MF $0.50

The sorptive behavior of two molybdenum films deposited at 60°C and −196°C was examined, and their physical properties were investigated by electron diffraction and microscopy. The hydrogen–deuterium exchange reaction was investigated further, particularly, the room temperature isotherms of hydrogen, deuterium, and their mixtures on molybdenum. Finally, a detailed study of the interaction of oxygen with niobium was pursued further.
NSA

N66-20373# California Univ., Berkeley. Lawrence Radiation Lab.
THE ELECTROMAGNETIC LEVITATION OF METALS: THE DESIGN, CONSTRUCTION, AND OPERATION OF A DIFFERENTIAL MICROMANOMETER; AND STUDIES OF ATOMIC HYDROGEN AT LOW PRESSURES

Peter Roland Rony (Ph.D. Thesis) 26 Apr. 1965 443 p refs (Contract W-7405-ENG-48)
(UCRL-16073) CFSTI: HC $7.43/MF $2.00

I. A complete theoretical description of the electromagnetic levitation of metals is given, leading to the basic equations for the lifting force and power input for a metal sphere levitated in an inhomogeneous sinusoidally alternating magnetic field. The suspended metal is suitably controlled either by operation at lower frequencies and addition of heat with an electron beam, plasma-arc torch, high-frequency induction heater, or reflection furnace, or by operation at high frequencies and employment of high-thermal-conductivity gases such as hydrogen and helium to cool the metal. Values indicating the case of levitation of 1-cm-radius spheres of more than 50 different metals at 0°C and at their respective melting points are given. When frequencies in the 10 to 100 kc/sec are used, the density of the metal chiefly determines the ease of levitation. Refractory, semiconducting, or dielectric materials can be levitated either by the heating of them to high temperatures to decrease their electrical resistivity or by the coating of a light and inert metal of high melting point with the material to be studied. Liquid sodium surrounded by a mineral oil of almost identical density can be used in the study of the magnetic-field distribution of levitation coils. Liquid mercury can be used to determine the ability of levitation coils to suspend high-temperature liquid metals. II. A differential micromanometer capable of measuring 100 μtorr to an accuracy of $\pm 2\%$ has been designed, constructed, and tested. The pressure difference is sensed by a membrane manometer constructed as a differential capacitor that forms two legs of a resonant-bridge network excited by a radio-frequency source. The most favorable system found to date consists of a pressure transducer (Decker Corporation Model 306-2A) operated open loop with the bridge and electronics. Differential pressures as low as 50 μtorr can be measured with a zero drift of 1 μtorr per min or 30 μtorr per hour. Differential pressures of 0.5 μtorr are detectable. The micromanometer is calibrated electrostatically. The diaphragm constant K in the formula, $\Delta P = K V^2$, is determined to $\pm 2\%$ by the comparison of a known voltage and a calibrated McLeod gage. III. The theoretical description of diffusion and flow tubes is extended to the following situations: (a) the discharge zone is of finite length, (b) the discharge-zone walls are inactive catalytically, (c) the end-plate sink is composed of two or more catalytic materials, and (d) the atom-recombination coefficients on the discharge- and reactor-zone walls differ in magnitude. The dimensionless groups characterizing the rate processes within the system are systematized. A Wrede-Harteck gage, which is capable of detecting atom concentrations of less than 0.06% at 75 mtorr, indicates that the presence of small amounts of water does not influence the yield of atomic hydrogen from a microwave or 50-MHz discharge. This result is independent of the measurement technique, the source of hydrogen, the source of water, and the discharge power. Small amounts of oxygen stoichiometrically increase the yield of atomic hydrogen from the low-pressure discharge by a ratio of at least two atoms of hydrogen per molecule of oxygen. Molecular nitrogen has a similar but smaller effect. The location of an active catalytic probe affects the atom-concentration level throughout a diffusion tube. A cyclotron-resonant microwave discharge operates in the low-pressure system with powers as low as 250 mw. The intensity of the Balmer lines or color of low-pressure hydrogen discharges is not a reliable qualitative indication of the atomic-hydrogen yield. Requisite conditions for the proper use of an isothermal calorimeter are also discussed. Author (NSA)

N66-20377*# Oak Ridge National Lab., Tenn.
EXPERIMENTAL SIMULATION OF LARGE, HIGH FIELD, SUPERCONDUCTING MAGNET OPERATION First Quarterly Report, Mar. 1–May 31, 1965
W. F. Gauster, D. L. Coffey, and H. A. Ullmaier 23 Jun. 1965 60 p refs
(NASA Order H-76798; Contract W-7405-ENG-26)
(NASA-CR-71614; ORNL-TM-1173) CFSTI: HC $3.00/MF $0.50 CSCL 20C

A series of new sample coils with 4- to 5-in. outside diameters for tests in the 6-1/2-in., 80-kilogauss magnet was procured. Results of tests with several of these coils are reported. Preparations for experiments in a new 13-in. bore magnet facility are progressing. The extensive recent literature on the physics of type III superconductors is being studied. A brief digest of a selection of several important new results is presented along with some detailed new studies on similar subjects. Author (NSA)

N66-20393# Institute of Mathematical Science, Madras (India).
THEORIES OF GRAVITATION
J. V. Narlikar [1965] 54 p refs *Its* Matscience Rept.-39 (NP-15486)

Separate discussions are presented on the following; the electromagnetic field, principle of equivalence, the curvature tensor, Einstein's equations, experimental verification, Mach's principle, steady state cosmology, action at a distance, Maxwell's field from direct particle interactions, radiation damping, retarded and advanced potentials in curved space-time, "C" field theory, and Hoyle–Narlikar theory of gravitation. NSA

N66-20398# Oak Ridge National Lab., Tenn.
ORBITS IN A MAGNETIC UNIVERSE
M. A. Melvin and J. S. Wallingford (Fla. State Univ.) Jul. 1965 14 p refs Work done in part at Fla. State Univ.
(Contract W-7405-ENG-26)
(ORNL-3827) CFSTI: HC $1.00/MF $0.50

A cylindrically symmetric parallel bundle of magnetic lines of force, in equilibrium under their mutual gravitational attraction ("magnetic universe"), has recently received attention. While a Newtonian analysis suggests that the equilibrium is unstable, the complete general relativity analysis shows that the equilibrium is stable. This discrepancy may have to do with the unusually slow falloff of the gravitational field at large distances in this geometry. In order to understand the gravitational field of the static magnetic universe somewhat better, its time-like and lightlike geodesics (i.e., the orbits in it of electromagnetically neutral test particles with unit or zero rest mass) are studied. Since the density of magnetic flux—and energy and stress and, therefore, "gravitating mass"—is approximately uniform in the vicinity of the axis, the motion of test particles there is like that in a Newtonian simple harmonic oscillator field. "Vicinity" here means within a small fraction ρ of the range radius $\bar{a}=(6.96/B_o)\times 10^{24}$ cm (B_o is the magnetic field on the axis measured in gauss). As is to be expected from the unversality of the angular frequency ω_o in the harmonic oscillator field and the relation orbital velocity $\simeq\omega_o\rho$, no motion can get too far from the axis. Otherwise the physical orbital velocity would exceed the speed of light. It is in this way that the strength of the attractive field, though it does not remain strictly of the harmonic oscillator type as one proceeds outward, implies that there is a critical straddling radius $\rho=1\sqrt{3}$. Circular or circular helical light tracks occur only at the critical radius.

and with $B_0 = 10^5$ gauss, the time required for light to circumnavigate the critical circle is about 200 years. The cylinder marked out by this radius plays a unique limiting role: All particles, whether of zero or nonzero mass, and no matter what their initial positions and velocities (except in the one singular subcase of light tracks parallel to the cylindrical axis), must have their orbits lying wholly or partially within the cylindrical region $\rho < 1/\sqrt{3}$; hence the use of the adjective "straddling." Constants of motion which correspond closely to ζ-component linear momentum, angular momentum, and energy in Newtonian mechanics are defined. Bounds are placed on these dynamical constants and on the apsidal radii by the requirement that the range of motion be real. Finally, the magnetic universe is complete in the sense that "no news can enter or leave"—all orbits are of infinite duration.

Author (NSA)

N66-20422# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

THE DIFFRACTION ANALYSIS OF DISLOCATION LOOPS—A LITERATURE REVIEW

J. H. Chute Mar. 1965 15 p refs

(AAEC/TM-283)

The various methods available for the determination of the nature of dislocation loops observed by transmission electron microscopy are discussed and compared. Author

N66-20442# Los Alamos Scientific Lab., N. Mex.

ANALYSIS OF SHOCK WAVE AND INITIATION DATA FOR SOLID EXPLOSIVES

J. B. Ramsay and A. Popolato [1965] 5 p refs Presented at the 4th Symp. on Detonation, Silver Spring, Md.

(Contract W-7405-ENG-36)

(LA-DC-6992; CONF-651003-3)

If the usual analysis of shock-wave data is made for polycrystalline plastic-bonded HMX and pressed TNT, the experimental data extrapolate to the detonation pressure point rather than to the peak spike pressure point. This is indicative of a reactive wave, which is to be expected. Limitations based on the assumptions and analysis are discussed to show that it is not possible to infer any information about the shock properties of unreacted explosive from the available shock-wave data for solid explosives. Since no calculational model is available which will permit the computation of the details of initiation of solid explosives, empirical relationships are presented to summarize the data for engineering purposes. Author (NSA)

N66-20449# Mound Lab., Miamisburg, Ohio.

THE LIQUID DENSITIES OF CERIUM AND NEODYMIUM METALS

William G. Rohr Mar. 1965 9 p refs Presented at 5th Rare Earth Res. Conf., Ames, Iowa.

(Contract AT(33-1)-GEN-53)

(CONF-650804-6) CFSTI: HC $1.00/MF $0.50

The density of liquid neodymium and additional data on the density of liquid cerium were determined by a vacuum pycnometric method as a function of temperature. For neodymium, liquid density measurements made from near its melting point to 1231° C exhibited a temperature dependence expressed as: $\rho = [7.373 - (5.28 \times 10^{-4})(°K)] \pm 0.019$ g/cc. Liquid cerium density measurements were extended to 1173° C. The combined cerium data yielded a temperature dependence which could be expressed as: $\rho = [6.930 - (2.27 \times 10^{-4})(°K)] \pm 0.027$ g/cc. Author (NSA)

N66-20453# Hanford Atomic Products Operation, Richland, Wash.

NONLINEAR MODEL DETERMINATION OF CONCENTRATION PROFILES IN TWO-PHASE COUNTERCURRENT EXTRACTORS

N. P. Wilburn and W. L. Nicholson 18 Aug. 1964 27 p refs

(Contract AT(45-1)-1350)

(HW-SA-3484) CFSTI: HC $2.00/MF $0.50

In two-phase continuous countercurrent extractors, the continuity equation describing the mass transfer process occurring may be written in the following form for the "rth" (either x or y) phase $\partial \epsilon_r c_i / \partial t = -\text{div}\,(E_r \epsilon_r \text{ grad } c_i) - \text{div}\,(\mu_r \epsilon_r c_r) - \psi(c_r c_s)$, where ϵ_r = volumetric fraction of the "rth" phase at (z, R, θ, t); c_r, c_s = concentration of the solute in the two phases at (z, R, θ, t); E_r = Fick type diffusion coefficient for the "rth" phase; μ_r = velocity of the "rth" phase; ψ = rate of mass transfer occurring between the two phases; and (z, R, θ, t) = cylindrical and time coordinates. The equation is solved for the same boundary conditions as previous work but ϵ_r is not held constant and c^* is assumed to be an arbitrary function of c_y. The solution is obtained by dividing the extractor into n segments. ϵ_r is assumed to be constant (or a linear function of z), and c_x^* is represented by $M_i c_y + q_i$ over the "ith" segment. This approach replaces the nonlinear systems by n linear systems. M_i, q_i, and the length of segment are chosen such that the set of n straight lines ($c_x = M_i c_y + q_i$, i = 1,...n) represents the "best fit" to the nonlinear function $c_x^*(c_y)$ over the range of concentrations that c_y exhibits in the extractor. The solution for the two concentrations c_x, c_y and their space derivatives at the segment boundaries requires the inversion of a 4n by 4n matrix. It is shown that this problem is reducible to the inversion of n 4 by 4 matrices. A solution is obtained for a case typical of that occurring in the stripping column for the uranyl nitrate–water–TBP–kerosene system, where the equilibrium function c_x^* is approximately sigmoidal in c_y, and ϵ_r is an exponentially damped polynomial function of z. This solution is compared with that obtained by assuming that ϵ, M, q are constant over the extractor. Author (NSA)

N66-20473# California Univ., Livermore. Lawrence Radiation Lab.

EFFECT OF AN INELASTIC CHANNEL ON THE POSITION AND WIDTH OF A RESONANCE

M. Der Sarkissian and Pran Nath 15 Jan. 1965 10 p refs

(Contract W-7405-ENG-48)

(UCRL-12344) CFSTI: HC $1.00/MF $0.50

A simple model is constructed to study the effect of adding one extra channel in an N/D calculation of the position and width of a resonance. It is found that the mass of the resonance is shifted toward threshold. This means the effect of the extra channel is always to add an attractive force. The situation with regard to the width is ambiguous and requires more detailed numerical calculations. Author (NSA)

N66-20484# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

FORMULATION OF A SCALAR QUANTUM FIELD THEORY WITH ESSENTIALLY NONLINEAR INTERACTION [K FORMULIROVKE KVANTOVOI TEORII SKALYAPNOGO POLYA S SUSHCHESTVENNO NELINEINYM VZAIMODEISTVIEM]

G. V. Efimov 1965 16 p refs In RUSSIAN

(JINR-P-1960)

In scalar quantum field theory with a local, essentially nonlinear interaction a method is suggested of constructing an S-matrix which is finite in all orders of perturbation theory. The construction is made for the amplitudes of physi-

cal processes in the Euclidean region of space-like external momenta. It is shown that there is a principal nonuniqueness arising in the formulation of the problem.
Author (NSA)

N66-20551# Argonne National Lab., Ill.
INNOVATIONS IN BUBBLE CHAMBER DEVICES
E. G. Pewitt Jun. 1965 47 p refs Presented at Conf. on Instrumentation for High Energy Phys., Purdue Univ., Lafayette, Ind., 11–14 May 1965 Prepared in cooperation with Carnegie Inst. of Tech.
(Contract W-31-109-ENG-38)
(CONF-650510-14) CFSTI: HC $2.00/MF $0.50

Outstanding recent developments which make a new generation of bubble chambers economically and technically feasible are discussed. The performance of Scotchlite, a retrodirector for use in bright field bubble chamber photography, is discussed. The status of six large bubble chambers is briefly reviewed. The use of superconducting magnets and a hydrogen–neon mixture in large bubble chambers is considered.
NSA

N66-20562# California Univ., Livermore. Lawrence Radiation Lab.
COMMENTS ON PUMPING METHODS FOR OBTAINING ULTRAHIGH VACUUM
Norman Milleron 4 Jun. 1964 9 p refs Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-7925-T) CFSTI: HC $1.00/MF $0.50

A departure from standard practice is taken. Ultrahigh vacuum is not taken to be synonymous with a region of pressure only. Rather, vacuum is regarded as a permissive environment in which to work. A suggestion for a scale of vacuum permissiveness in grades from 1 to 20, 20 being defined as a perfect sink over 4π solid angle, is given. Pumping efficiency and where a pump begins are referred to. Brief remarks about combinations of pumps, especially cryo and titanium sublimation pumps, are given.
Author (NSA)

N66-20571# Vermont Univ., Burlington.
HIGH AMPLITUDE SOUND AS A PHYSICAL AGENT
Wesley L. Nyborg [1965] 7 p refs Presented at the 5th Intern. Acoust. Congr., Liege, 7–14 Sep. 1965
(Grant AF-AFOSR-62-63)
(AFOSR-65-2182; AD-627184) CFSTI: HC $1.00/MF $0.50

The time-independent velocity field or acoustic streaming, which is a second order quantity, is considered for the sonically generated changes in liquids. Effects of stable cavitation, the vibration of bubbles at sub-collapse levels, are included. Oscillatory first order motion of a bubble is discussed for the study of the streaming velocity field near a bubble. Probable effects of bubble-associated microstreaming on particles in suspension include velocity gradients of sufficient magnitude to fragment droplets and macromolecules. The effective shear region is stated to be a thin layer near the solid boundary adjoining the bubble. An expression is given for the rate at which fluid enters the boundary layer, and values of the average volume rate are appended.
E.A.O.

N66-20588# California Univ., Riverside.
THE ELECTRICAL PROPERTIES OF SEMIPERMEABLE MEMBRANES. II: UNIPOLAR FLOW—SYMMETRIC ELECTROLYTES Annual Summary Report, 1 Jan.–31 Dec. 1965
L. J. Bruner May 1965 46 p refs Submitted for Publication
(Contract Nonr-4443(00))
(AD-625470) CFSTI: HC $2.00/MF $0.50

A general formulation of the problem of stationary ion flow through semipermeable membranes was presented in the first paper of this series. The formalism is applied here to the evaluation of membrane conductance for the special case of unipolar ion flow between symmetric electrolytes. Thus it is assumed that the permeable ions carry one sign of charge only. Furthermore, the valences of all ions in solution on both sides of the membrane are taken to be of equal absolute magnitude. Conductance results obtained by numerical methods are presented for several representative sets of the parameters which characterize the membrane system in equilibrium. These results are discussed qualitatively with emphasis upon the contribution of particular system parameters to the non-linearities observed. Approximate analytic conductance relations, valid for high current levels, are also given.
Author (TAB)

N66-20594# General Electric Co., Schenectady, N. Y. Research and Development Center.
EFFECTS OF PRESSURE ON MAGNETIC INTERACTIONS Final Report, 1 Aug. 1964–31 Oct. 1965
J. S. Kouvel and C. R. Morgan Dec. 1965 10 p refs
(Contract Nonr-3893(00))
(AD-625486) CFSTI: HC $1.00/MF $0.50

A hydrostatic-pressure furnace system was designed, constructed, and assembled, and then tested at pressures up to about 10 kb. With this system, initial measurements were made at various fixed pressures of the critical temperature for the abrupt antiferromagnetic-ferromagnetic transition in the ordered alloy FeRh. The critical temperature, which is marked by a large sudden change in resistivity, was observed to increase rapidly with increased compression. This pressure dependence was then used quantitatively in evaluating the entropy change associated with the transition. The value thus obtained for the change in entropy agrees fairly closely with that recently deduced from the measured variation in critical temperature with applied magnetic field. Some discrepancy does exist, however, between these results and those previously derived from similar measurements. A fuller account of the pressure experiments with FeRh is given.
TAB

N66-20629 Joint Publications Research Service, Washington, D. C.
ACCELERATED MATCHINGS OF A GYROSCOPIC TRACKING SYSTEM
N. V. Kulikovskaya *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 6 11 Mar. 1966 p 254–265 refs (See N66-20606 10-10) CFSTI: $6.00

The problem of construction of an algorithm for the determination of the magnitude of control forces is solved. Under the effect of these control forces on a tracking system, the values of its coordinate coincide with the values of the coordinates of the target at discrete points in time.
Author

N66-20707# Naval Weapons Lab., Dahlgren, Va.
ACOUSTIC SPREADING LOSS IN AN INHOMOGENEOUS MEDIUM
Peter Ugincius and Lloyd E. Perkins Sep. 1965 37 p refs
(NWL-2003; AD-624459) CFSTI: HC $2.00/MF $0.50

A set of differential equations is derived for calculating the intensity loss due to geometrical spreading of planar sound rays in an inhomogeneous medium with a continuous index of refraction varying both in depth and horizontally. They are solved numerically for a mathematical model of an

ocean with a heat source. Intensity contours are presented for rays in the vicinity of a heat source and a heat sink. The heat sink causes the rays to converge which results in the formation of a caustic. An approximate formula is derived for the point where this caustic originates.
Author (TAB)

N66-20790 Mound Lab., Miamisburg, Ohio.
THE LIQUID DENSITIES OF CERIUM AND NEODYMIUM METALS
William G. Rohr *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 5: Met. Session M [1965] p 119–127 refs (See N66-20779 10-17)
CFSTI: HC $4.00/MF $1.00
(Contract AT-33-1-GEN-53)

The density of liquid neodymium and additional data on the density of liquid cerium were determined by a vacuum pycnometric method as a function of temperature. For neodymium, liquid density measurements made from near its melting point to 1231°C exhibited a temperature dependence expressed as: $\rho=[7.373-(5.28\times10^{-4})(°K)]\pm0.019$ g/cc. Liquid cerium density measurements were extended to 1173°C. The combined cerium data yielded a temperature dependence which could be expressed as $\rho=[6.930-(2.27\times10^{-4})(°K)]\pm0.027$ g/cc. Author

N66-20804# Oklahoma Univ. Research Inst., Norman.
HIGH PRESSURE PHYSICS LABORATORY Final Report
Stanley E. Babb, Jr. May 1964 103 p refs
(Contract Nonr-2982(05))
(AD-600902) CFSTI: $4.00

Topics include: historical survey of melting studies; apparatus; melting curves of pressure transmitting fluids; comparison of these methods with others; establishment of a valid pressure scale; establishment of a valid temperature scale; melting curve of KNO_3; results of metals; the phase diagram of $SbCl_3$ and $SbBr_3$; theory of the melting curve; miscellaneous melting results; metal block thermostats. TAB

N66-20834# Office of Naval Intelligence, Washington, D. C. Translations Section.
THE INVALIDITY OF A PURELY THERMODYNAMIC TREATMENT OF THE ADHESION OF SOLIDS
S. S. Voyuskiy and B. V. Deryagin 1965 5 p Transl. into ENGLISH from Kolloid. Zh. (Moscow), v. 27, no. 4 p 624–626
(ONI-TRANSL-2042; AD-625603) CFSTI: HC $1.00/MF $0.50

In view of the appearance of a number of foreign papers where adhesion of polymer adhesives is treated in terms of wetting the present communication discusses the basic principles of the thermodynamics of adhesion. It has been pointed out that there is no direct relation between wetting and adhesion of a polymer to a solid. A critical discussion has been made of the theory of Sharp and Schonhorn who consider adhesion as due to a spreading of the polymer adhesive along the surface of a substrate and it has been shown that a purely thermodynamic approach to the adhesion of polymers to solids is invalid. Author (TAB)

N66-20844# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics and Engineering Sciences.
CONTINUUM THEORY OF NONLINEAR VISCOELASTICITY
A. C. Eringen and R. A. Grot Oct. 1965 101 p refs Presented at the Meeting of the Intern. Conf. on the Mech. and Chem. of Solid Propellants, Lafayette, Ind., 19–21 Apr. 1965 Submitted for Publication
(Contract Nonr-1100(23))
(TR-32; AD-626187) CFSTI: HC $4.00/MF $0.75

An assessment of the recent developments in the field of nonlinear continuum mechanics is presented with the view of developing a systematic approach to the formulation of nonlinear theories of viscoelastic materials. Contact is established with various types of approximations useful in the treatment of engineering problems involving solid propellant materials. Author (TAB)

N66-20848# General Electric Co., Schenectady, N. Y. Research Lab.
STATIC OPTIMIZATION OF A DYNAMIC PROCESS
J. C. Friedly Jul. 1965 39 p refs
(Rept.-65-RL-3981-E)

The effectiveness of using a static optimization procedure to optimally control a dynamic process is considered, emphasizing the importance of the system time constants relative to the sampling time. A linear model of a chemical process is developed and used to obtain quantitative results on the performance of the control. A comparison is made of the system performance using quasi-static and dynamic optimization. Author

N66-20888*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
GRAVITATIONAL SHIELDING AND ABSORPTION Technical Report No. 508
J. Weber Sep. 1965 16 p refs
(Grant NsG-436)
(NASA-CR-71157) CFSTI: HC $1.00/MF $0.50 CSCL 20J

The general theory of relativity enables us to calculate gravitational shielding and absorption. These effects are analogous to the shielding of electromagnetic fields with the exception that, in lowest order, quadrupoles rather than dipoles are involved. Quasistatic shielding effects occur in the tides, and for some models the shielding effect is several percent of the applied field. The dynamic shielding is much too small to observe at this time. Author

N66-20891*# IIT Research Inst., Chicago, Ill. Technology Center.
INVESTIGATION OF LIGHT SCATTERING IN HIGHLY REFLECTING PIGMENTED COATINGS Quarterly Report, Nov. 1, 1965–Feb. 1, 1966
G. A. Zerlaut, B. H. Kaye, and M. R. Jackson 28 Feb. 1966 47 p refs
(Contract NASr-65(07))
(NASA-CR-71167; IITRI-U6003-17) CFSTI: HC $2.00/MF $0.50 CSCL 20F

The report begins with a discussion of the inadequacy of currently used terminology relating to reflective pigmented coatings. The two basic methods of drawing random intercepts on a circle are discussed. One method involves drawing lines between two random numbers on the circle's perimeter; the other involves drawing lines perpendicular to the radius for randomly selected angles to a fixed direction. The second method has a 33% longer track length than the first method. Since the absorption of light depends upon the time spent inside a particle (i.e., the average track length), the absorption factors for the two possible track systems should be quite different. A Monte Carlo grid-plotting experiment showed that the maximum number of independent scattering centers

occurs at a volume fraction of 17%; this is surprisingly close to the value of 20% obtained experimentally. The implications of the Monte Carlo studies for metal-filled conducting paints and filtration problems are discussed in detail. Author

N66-20979# Royal Aircraft Establishment, Farnborough (England).
EXPERIMENTAL DETERMINATION OF THE PRINCIPAL MOMENTS OF INERTIA OF AN AIRCRAFT OR SPACE VEHICLE [DETERMINATION EXPERIMENTALE DES MOMENTS PRINCIPAUX D'INERTIE D'UN AVION OU D'UN ENGIN]
R. Kappus and D. Clerc Oct. 1965 26 p refs Transl. into ENGLISH from French
(RAE-LIB-TRANS-1137) CFSTI: HC $2.00/MF $0.50

A method for determining the principal moments of inertia of an aircraft or space vehicle is proposed. The method employs a specialized ground resonance test which has yet to be fully developed. The analysis techniques employed have been checked theoretically on simple bodies having some 30 degrees of freedom and behaving in the same way as continuous structures. The required ground resonance test results were calculated and not obtained experimentally. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-19786# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.
POLARIZATION IN HIGH-ENERGY π-P SCATTERING AND THE BYERS-YANG MODEL
Michel Le Bellac Feb. 1966 12 p refs
(TH-132) CFSTI: HC $1.00/MF $0.50

By assuming that asymptotic expansions exist for pion–nucleon scattering amplitudes, the Byers and Yang coherent droplet model of high energy exchange processes can be used to make predictions about the polarization in elastic and charge exchange π-P scattering. Despite the experimental difficulties, these polarization measurements are considered extremely useful for a better understanding of high energy phenomena. The asymptotic expansions are written in the same way as for elastic scattering of two spinless particles, helicity amplitudes are calculated, and the polarization is expressed in terms of three functions of the helicity amplitudes. M.W.R.

N66-19788# Portugal. Nuclear Energy Commission, Sacavem. Physics and Nuclear Energy Lab.
PREPARATION OF SAMPLES FOR THE METALLOGRAPHIC STUDY OF SOME URANIUM ALLOYS [PREPARACAO DE AMOSTRAS PARA O ESTUDO METALOGRAFICO DE ALGUMAS LIGAS DE URANIO]
A. Oliveira Sampaio 1964 23 p refs In PORTUGUESE with German repr. "Polished Sectioning of Uranium-Iron-Cobalt Alloy" from Prakt. Metallog. (Germany) v. 1, no. 4, 1964 p 165–166
(LFEN.34(a))

Various polishing methods for uranium-iron-cobalt alloys were evaluated. A vibrational polishing technique utilizing silicon carbide sanding paper gave the best preparation of intermetallic uranium sample surfaces because it did not destroy the involved grain structures. Transl. by G.G.

N66-19795# Liege Univ. (Belgium).
ACCELERATOR TARGETS DESIGNED FOR THE PRODUCTION OF NEUTRONS [BESCHLEUNIGERTARGETS BESTIMMT ZUR HERSTELLUNG VON NEUTRONEN. CIBLES POUR ACCELERATEURS DESTINEES A LA PRODUCTION DE NEUTRONS]
Brussels, EURATOM, 1966 397 p refs In ENGLISH, GERMAN, and FRENCH Proc. of the Meeting held at Grenoble, France, 21–22 Jun. 1965
(Contract EURATOM-050-63-8 RISB)
(EUR-2641.d, f, e) CFSTI: HC $7.00/MF $2.00

Accelerator targets designed for the production of mono- and polyenergetic neutrons were studied during the conference. Discussions turned mainly on tritium accelerator targets in order to improve their performances particularly with regard to time of use and neutron flux. Author

N66-19861# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
PROGRESS REPORT OF THE "SANITA SOTTOSEZIONE" OF THE INFN FOR THE PERIOD 1964–65 [RELAZIONE SULL'ATTIVITA DELLA SOTTOSEZIONE "SANITA" DELL'INFN NEL 1964–65]
5 Nov. 1965 35 p refs In ITALIAN; ENGLISH summary
(ISS-65/41) CFSTI: HC $2.00/MF $0.50

This report deals with the activities of the "Sanità Sottosezione" of the INFN during the year 1964–65. Research work in the fields of elementary particle physics, nuclear physics, solid state physics and electromagnetic interactions is described. A brief account of the activities of the theoretical group and of the Computing Centre is also given. Author

N66-19862# American Meteorological Society, Boston, Mass.
THE ELEMENTS OF THE ELECTROSTATIC INTERACTION OPERATOR MATRIX FOR ONE ELECTRON OUTSIDE A HALF-FILLED SHELL OF d ELECTRONS [MATRICHNYE ELEMENTY OPERATORA ELEKTROSTATI-CHESKOGO VZAIMODEISTVIIA DLIA ODNOGO ELEKTRONA VNE POLUZAPOLNENNOI OBOLOCHKI d ELEKTRONOV]
A. V. Karosene, A. Iu. Savukinas, and A. P. Iutsis Bedford, Mass., AFCRL, Sep. 1965 29 p refs Transl. into ENGLISH from Litovsk. Fiz. Sb. (USSR), v. 4, no. 2, 1964 p 213–231
(Contract AF 19(628)-3880)
(T-R-465; AD-476070)

Radial integrals are used to express the matrix elements of the energy operator of electrostatic interaction between a l electron and a half-filled shell of d electrons in the case of LS coupling. The coefficients of the radial integrals are expressed by the one-electron quantum number l of the outer electron and the whole orbital quantum number L. Author (TAB)

N66-19870# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ELECTROMAGNETIC INELASTIC VERTEX
J. Micheli Dec. 1965 26 p refs
(TH/117) CFSTI: HC $2.00/MF $0.50

The matrix element structure of an electromagnetic current between two different spin particles was studied by the electromagnetic interactions of photodisintegration and photoproduction, and evaluation of the total inelastic electron-nucleus scattering cross sections. Photodisintegration and photo-

production probabilities were described through a number of coupling constants, and the structure of the electromagnetic vertex for a virtual photon was defined by form factors and written as a function of the electromagnetic current. The electron nucleus cross section for the function of these form factors was calculated and applied to the particular case of elastic vertex through definition of the corresponding coupling constants. G.G.

N66-19879# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
DO WEAK INTERACTIONS INVOLVE NON-OCTET CURRENTS?
B. d'Espagnat and M. K. Gaillard Feb. 1966 14 p refs
(TH/133) CFSTI: HC $1.00/MF $0.50

A hypothesis that attributes the formation of vector octets and axial vector octets in the SU_3 symmetry to weak currents from the leptonic decay of hadrons was studied. It was assumed that the currents in "10", "10" or "27" were coupled to leptons along with the usual current in "8", and that a weak hypercharge "Y" was conserved in these couplings. Theoretical evaluation of the relationship between semi-leptonic transition amplitudes and the second leptonic amplitude established the presence of "extra" currents of short durability due to a superimposition effect. No positive evidence for non-octet current participation in weak decay interactions was found. G.G.

N66-19886# Queens Coll., Flushing, N. Y. Dept. of Physics.
REPORT ON THE TRIENNIAL CONFERENCE ON GENERAL RELATIVITY, GRAVITATION, AND ALLIED TOPICS HELD AT IMPERIAL COLLEGE, LONDON, U.K., JULY 1–9, 1965
A. L. Harvey 1 Dec. 1965 16 p refs
(Grant Nonr(G)-00037-65)
(TR-1; AD-626787) CFSTI: HC $1.00/MF $0.50

The history of previous relativity conferences is discussed. Highlights of the 1965, London conference are given. TAB

N66-19943# Portugal. Nuclear Energy Commission, Sacavem. Lab. of Physics and Nuclear Engineering.
STUDY OF THE THIRD U-V-Cr SYSTEM [ESTUDO DO SISTEMA TERNARIO U-V-Cr]
Armando de Oliveira Sampaio and Maria de Lourdes Pinto 1964 37 p refs In PORTUGUESE; ENGLISH summary Revised Presented at 27th Congr. Luso-Espanhol Para o Progresso das Ciencias, Bilbao, Spain, 20–24 Jul. 1964
(LFEN.24 (α)) CFSTI: HC $2.00/MF $0.50

The system U-V-Cr was studied using microscopic, thermal, dilatometric, chemical and X-ray methods. Isothermal sections at 1000°, 730° and 645°C and three temperature-concentration sections were investigated. No intermetallic compounds or four phase equilibria were observed. The mechanism of retention of uranium β-phase in this ternary system seems to be identical to those previously reported for the binary systems U-V and U-Cr. Author

N66-20032# European Organization for Nuclear Research, Geneva (Switzerland).
CONTRIBUTION TO THE STUDY OF A CLOSED ORBIT [CONTRIBUTION A L'ERUDE DE L'ORBITE FERMEE]
Y. Baconnier Nov. 1965 70 p refs In FRENCH
(CERN-65-35)

The method of calculation is presented, along with a computer program, for the determination of the characteristic parameters of particle trajectories in a cyclotron, both for the case of linear perturbations and for the case of nonlinear perturbations. The basic theory for the computation is discussed, and the equations upon which the computer program is based are derived. The means for correcting random errors are also considered. Transl. by D. T.

N66-20034# United Kingdom Atomic Energy Authority, Harwell (England). Radiological Protection Div.
COMPUTED DEPOSITION RATES PER UNIT RELEASE RATE OF WINDBORNE MATERIAL
Pamela M. Bryant Sep. 1965 43 p refs
(AHSP(RP)-M-40)

Methods of calculation of dry deposition rates, washout by rain, and combined, i.e., wet and dry, deposition rates, all with respect to unit rate of release to atmosphere are described. Computed values of these deposition rates corresponding to several alternative values of deposition velocity and of the washout coefficient over a range of stack heights and distances, are given in tabular form for use as ready-reckoners. The computer program includes calculation of derived working limits for continuous release rates of ^{90}Sr and ^{137}Cs to atmosphere in a milk producing area in Great Britain and these values are included. Author

N66-20035# European Atomic Energy Community, Brussels (Belgium).
A IREK-PUL: A VERSION OF THE KINETIC CODE AIREK-MOD FOR PERIODICALLY PULSED FAST REACTORS
A. Inzaghi and R. Misenta 1965 84 p refs
(EUR-2552.e) CFSTI: HC $3.00/MF $0.75

For kinetic calculations of a periodically pulsed fast reactor the code AIREK-MOD has been supplemented. The new code AIREK-PUL integrates the kinetic equations for a periodically pulsed reactor for two space points and few neutron groups and for one group with an external neutron source. The kinetic equations solved by the code AIREK-PUL are described and the listings of the three versions of the code are given in the report. Author

N66-20047# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
FUNCTION OF EXCITATION FOR THE REACTION Au^{197} (d,p) Au^{198} [FUNCION DE EXCITACION PARA LA REACCION Au^{197} (d,p) Au^{198}]
S. J. Nassiff, E. Quel, and J. Testoni 1965 13 p refs In SPANISH
(CNEA-160) CFSTI: HC $1.00/MF $0.50

The excitation function for the reaction Au^{197}(d,p) Au^{198} was experimentally determined. A method of superimposed metallic gold leaves was used. The deuteron energy in the incident side was 27.5 MeV. The results were compared with calculated values based on a model proposed by Peaslee that assumes a direct reaction mechanism.
Transl. by R.N.A.

N66-20061# France. Ministere de l'Air, Paris.
STUDY ON OPTICAL PUMPING OF THE RELAXATION OF RUBIDIUM ATOMS [ETUDE PAR POMPAGE OPTIQUE DE LA RELAXATION D'ATOMES DE RUBIDIUM]
Marie-Anne Bouchiat 1965 174 p refs In FRENCH
(NT-146) CFSTI: HC $5.00/MF $1.00

In the study of spin relaxation processes, an experiment was conducted on rubidium adsorption by a paraffin coated surface. The disorientation of rubidium atoms during collisions on the walls is thought to be due to the dipole–dipole interaction between the nuclear spin of the coating protons and the electronic spin of the alkaline. Optical methods were used to detect the orientation, with the observations dependent upon the characteristics of the ray beam employed, i.e., di-

rection, polarization, and spectral composition. It is pointed out that the theoretical study describing the relaxation process is applicable to other magnetic type interactions.
Transl. by D.T.

N66-20065* Naval Ordnance Test Station, China Lake, Calif. Michelson Lab.
THE IMPORTANCE OF RELATIVISTIC EFFECTS IN THE SCATTERING OF SLOW ELECTRONS
H. N. Browne and E. Bauer *In its* Theoret. and Exptl. Invest. of the Phys. of Crystalline Surfaces 31 Jan. 1966 10 p refs (See N66-20067 10-26) CFSTI: HC $2.00/MF $0.50

Total and differential cross sections for slow electrons were calculated using relativistic effects in the static central field approximation. The influences of extra terms in relativistic equations were determined for He, Kr, Cs, and Hg for 2, 20, and 200 eV electrons in order to obtain quantitative information on the energy and Z_o (nuclear charge) dependence of the difference between nonrelativistic and relativistic scattering cross sections. Results indicated that the relativistic effects: (1) increased with the nuclear charge Z_o; (2) decreased with increasing electron energy; (3) existed independent of the type of potential used; and (4) either increased or decreased the total scattering cross sections. The number of partial waves in which relativistic effects are significant increased with Z_o and k2 (kinetic energy). It was concluded that relativistic effects, together with exchange and polarization phenomena, have to be considered in order to obtain reliable cross sections of heavy atoms for slow electrons. G.G.

N66-20140*# TRW Systems, Redondo Beach, Calif. Physical Electronics Lab.
IMPACT IONIZATION FROM FRAGILE TARGETS
J. F. Friichtenicht Jul. 1965 10 p refs
(Contract NASw-936)
(NASA-CR-71015; TRW-4158-6012-TU-000) CFSTI: HC $1.00/MF $0.50 CSCL 20H

An experiment was conducted to study the effect of target structure on the amount of ionization produced upon impact by a high velocity particle. Measurements were made using an electrostatic hypervelocity accelerator. Two types of targets were used; one was a solid iron target while the other was a particulate target made up of carbonyl iron spheres. The results are illustrated graphically where the net charge produced Q is normalized to particle mass and plotted as a function of velocity for both types of targets. Within the scatter exhibited by the data points, there appears to be no marked difference in the impact ionization produced between the two types of targets at high velocities. At lower velocities, less charge is produced by impact on the particulate target. The particulate target was examined with an optical microscipe following particle bombardment. Although no quantitative measurements were made, it was evident that much larger craters were formed in the particulate target than in the solid iron target. R.N.A.

N66-20148# Naval Radiological Defense Lab., San Francisco, Calif.
A COMPUTER PROGRAM FOR CALCULATING FISSION PRODUCT ABUNDANCES
Michael A. Hogan, John K. Crawford, and V. Goddard (Computer Usage Corp.) 15 Oct. 1965 172 p
(USNBDL-TR-921; AD-627235) CFSTI: HC $5.00/MF $1.00

The Fission Product Abundances Program is a generalized digital computer method for calculating time dependent abundance of fission products. The times at which the abundances are calculated, the reactor operating history, and the fission type (fissile material and fission spectrum) are all input variables. In addition, several different outputs are available. The combination of these features yields a very general program intended to meet the needs of many users. Author (TAB)

N66-20168# Chicago Univ., Ill. Dept. of Physics.
MOLECULAR STRUCTURE AND SPECTRA Quarterly Status Report, 1 Jul.-30 Sep. 1965
Robert S. Mulliken [1965] 10 p
(Contract Nonr-2121(01))
(QSR-35; AD-623416) CFSTI: HC $1.00/MF $0.50

Work is summarized on molecular structure and spectra. Emission spectra of He_2 and Bromine are discussed. Work on Rydberg-Klein-Rees potential energy curves, chemical bonding in diatomic molecules, and Rydberg states of diatomic molecules in summarized. TAB

N66-20189# Atomic Weapons Research Establishment, Aldermaston (England).
A 12 GROUP SET OF PHOTON CROSS SECTIONS FOR USE IN ANISOTROPIC S_N CALCULATIONS OF PHOTON TRANSPORT
W. M. M. Kerr, K. Parker, D. V. J. Williams, and Patricia M. Wilton Oct. 1965 42 p refs
(AWRE-O-79/65) CFSTI: HC $2.00/MF $0.50

The 12 group set 2 photon cross sections calculated for use in STRAINT and other programmes in which anisotropic scattering can be taken into account is described. All the numbers required are given in the form of SC4020 prints so that the cross sections can be used in other programmes.
Author

N66-20210# California Univ., Berkeley. Lawrence Radiation Lab.
NUCLEAR SPECTROSCOPIC STUDIES OF ^{204}Po
Jiann-min An (M.S. Thesis) 5 Aug. 1965 26 p refs Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-16324) CFSTI: HC $2.00/MF $0.50

Sources of polonium 204 were derived from the electron capture decay of astatine 204 made by bombarding ^{197}Au with ^{12}C in the Heavy Ion Linear Accelerator at Berkeley. Physical and chemical methods were adjusted to make the sources as pure as possible for the measurements. Using scintillation crystals coupled to a 400 channel pulse height analyzer, an investigation of some of the nuclear radiations of ^{204}Po was made. Gamma rays from ^{204}Po were identified by their half life; their energies and relative intensities were carefully determined and the alpha branching ratio was measured. Author (NSA)

N66-20214# California Univ., Livermore. Lawrence Radiation Lab.
PRODUCTION OF 44-Å CARBON X-RAYS BY 15-KeV TO 110-KeV PROTONS
J. M. Khan, D. L. Potter, and R. D. Worley 27 Apr. 1964 19 p refs Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-7826) CFSTI: HC $1.00/MF $0.50

Characteristic K-shell X-rays (44Å) from carbon were produced by proton bombardment of a thick target. A flow mode proportional counter (20 cm Hg pressure: 96% He, 4% isobutane) was used to observe the photons. The thick target X-ray yield was measured over the bombarding energy range from 15 to 110 keV. With estimates of the stopping power of the carbon for the protons and the mass absorption coefficient for self absorption, the X-ray production cross section was obtained. With a value for the fluorescence yeild of 0.007, the

ionization cross section is obtained. The varies from 6×10^{-24} cm^2 to 4×10^{-20} cm at 15 keV and 110 keV, respectively. With direct observation of carbon X-rays as a tool, contamination buildup on copper and aluminum was studied as a function of proton current and time. A two-parameter empirical relation was obtained of the form: $n=n_0+\beta(1-e^{-\alpha ip})t$ in units of carbon atoms/cm^2, where $\beta=0.7\times10^{16}$ atoms/cm^2-min, $\alpha=0.35$ sec/μamp with t in minutes. (System pressure was 1.5×10^{-6} mm Hg, I_p taken at 1.5, 5, and 20 μamp). The results indicated that carbon was the principal contaminant.

Author (NSA)

N66-20220# California Univ., Livermore. Lawrence Radiation Lab.

COMPARISON OF RECENT PION–NUCLEON PHASE SHIFT ANALYSES

L. David Roper 26 Apr. 1965 74 p refs

(Contract W-7405-ENG-48)

(UCRL-12383) CFSTI: HC $3.00/MF $0.75

An attempt is made to evaluate which of several pion–nucleon phase shift analyses in the 300- to 700-MeV region best fits the experimental data. The various solutions were compared by fitting them with the parameterization used in one analysis, and a χ^2 determination was used to improve the fit. Results are presented, giving phases shifts, absorption parameters, and real and imaginary parts of partial wave amplitudes. Polarizations for the various solutions are also compared. The behavior of the polarizations and the spin rotation parameters as functions of energy is shown for the best solution, that of Auvil et. al. (Phys. Letters 12, 78, 1964) combined with the P_{11} and S_{11} resonances from other solutions. NSA

N66-20223# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Theoreticheskoi i Eksperimental'noi Fiziki.

ON THE CHEMICAL REACTION OF MUONS. IDENTIFICATION OF REACTION PRODUCTS [O KHIMICHESKIKH REAKTSIYAKH MYUONIYA. IDENTIFIKATSIYA PRODUKTOV VZAIMODEISTVIYAS VESHCHESTVOM]

V. G. Firsov 1964 12 p refs In RUSSIAN; ENGLISH summary

(NP-15389)

The dependence of the μ^+ spin precession on the chemical compound in whose composition the muon appears is considered for various magnetic fields. It is shown that identification according to classes of compounds, and also finer distinction according to the precession frequencies of meson–nucleus spin systems, is possible. Author (NSA)

N66-20224# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

ON THE T-PARITY NONCONSERVATION IN STRONG INTERACTIONS [O NESOKHRANENII VREMENNOI CHETNOSTI V SIL'NYKH VZAIMODEISTVIYAKH]

G. A. Lobov 1965 7 p refs In RUSSIAN; ENGLISH summary Rept.-340

(NP-15457)

The correlation between two cascade γ-quanta emitted by an excited polarized nucleus is calculated. This correlation is considered taking into account the phenomenon of the time reversion noninvariance in strong interactions for an arbitrary case of mixed γ-transitions. The expected effect of the T-violation in strong interactions is discussed. Author (NSA)

N66-20230# Oak Ridge National Lab., Tenn. Health Physics Div.

INVESTIGATION OF PLASMA RADIATION FROM ELECTRON BOMBARDED ALUMINUM FOILS AS A FUNCTION OF THE ANGLE OF OBSERVATION AND THE FOIL THICKNESS

W. F. Hanson (M.A. Thesis—Vanderbilt Univ.), R. J. Herickhoff, E. T. Arakawa, and R. D. Birkhoff Jun. 1965 65 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1126) CFSTI: HC $3.00/MF $0.75

The angular distribution of photons emitted from aluminum foils 320 Å in thickness bombarded with 80 kev electrons, and the dependence of the peak intensity of foil thickness were determined experimentally in the wavelength region from 700 to 1100 Å. The absolute efficiency of the optical spectrometer was determined in the visible wavelength region from a standard lamp and extrapolated into the vacuum ultraviolet wavelength region using the measured grating efficiency and the quantum efficiency of sodium salicylate. Experimental photon intensities were found to be approximately 40% lower than the photon intensities predicted by the transition radiation theory. The intensity of the emission at the peak wavelength exhibited maxima at 22° and 157° from the foil normal; the intensity dropped to zero at 0°, 180°, and 90°. The angles for which the theoretical curves exhibit maximum intensity are 15° and 168°. The wavelength for which the experimental spectra exhibit maximum intensity was found to decrease as the angle of observation increased from 0° or decreased from 180°. A plot of the wavelength of maximum emission versus the angle of observation was extrapolated to 0° to obtain the plasma wavelength, 835 Å. The intensity of the wavelength of maximum emission was found to decrease rapidly as the foil thickness was increased from 180 to 400 Å and then to remain fairly constant out to 700 Å. The experimental results are in good agreement with transition radiation theory.

Author (NSA)

N66-20241# European Organization for Nuclear Research Geneva (Switzerland). Theoretical Study Div.

ON THE GENERALIZATION OF THE ISOPARITY

L. C. Biedenharn, J. Nuyts, and H. Ruegg 11 Jan. 1965 51 p refs

(CERN-65-3)

The generalization of the isoparity (G parity) to internal symmetry groups which belong to any of the four families of compact simple and simply connected Lie groups is explicitly carried out. The extended isoparity is shown to depend upon the structure of the groups in question, and the required structure is developed in detail. The properties of the extended isoparity are discussed, and two cases—strong G parity and weak G parity—are shown to arise. The relation between the isoparity extension and superselection rules is briefly discussed, and a concluding section illustrates, by example, the possibility of other extensions available in direct products. This example is of intrinsic interest since, for example, it allows an internal (symmetry) distinction between meson and baryon octets that excludes meson decuplets. Author (NSA)

N66-20242# Naval Radiological Defense Lab., San Francisco, Calif.

HALF-LIVES OF Eu^{156} AND Eu^{157}

C. L. Carnahan and L. R. Bunney 29 Apr. 1965 19 p refs

(Contract AT(49-2)-1167)

(USNRDL-TR-868) CFSTI: HC $1.00/MF $0.50

The half lives of ^{156}Eu and ^{157}Eu were remeasured. Values of 15.21 ± 0.24 days and 15.23 ± 0.03 hours, respectively, were obtained by following the beta decay. A number of

gamma energies and relative abundances were obtained for the decay of ^{157}Eu. These were 314(0.05), 369(0.30), 407(1.00), 482(0.34), 629(0.16) and 702(0.06) keV.
Author (NSA)

N66-20247# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
CALCULATION OF INELASTIC SCATTERING OF NEUTRONS IN THE MeV REGION
E. H. Auerbach and S. O. Moore (Brookhaven Natl. Lab.) [1965] 6 p Presented at the Intern. Conf. on the Study of Nucl. Struct. with Neutrons, Antwerp
(Contract AT(30-1)-2098)
(MIT-2098-152; CONF-650706-14) CFSTI: HC $1.00/MF $0.50

A model for inelastic scattering of neutrons by nuclei in the range up to several MeV is presented. The Hauser-Feshbach theory is assumed to explain the inelastic and compound elastic parts of the scattering to a high degree of approximation. The assumption that the complex potential describing the elastic part of the scattering is adequate to provide the transmission coefficients applicable to the excited states which are required for the Hauser-Feshbach calculation is made. NSA

N66-20253# California Univ., Livermore. Lawrence Radiation Lab.
DISSOCIATION OF VIBRATIONALLY EXCITED MOLECULAR HYDROGEN IONS ON HYDROGEN GAS
E. S. Chambers 24 Jun. 1964 15 p refs
(Contract W-7405-ENG-48)
(UCRL-7946) CFSTI: HC $1.00/MF $0.50

By appropriate operation of the hydrogen ion source, H_3^+ ions were obtained that have an abnormally high cross section for the dissociation reaction $H_3^+ + H_2 \rightarrow H_2^+ + H + H_2$. The cross section increases with energy from 6 Å^2 at 5 keV to 10 Å^2 at 50 keV. Normal ions gave 1.5 Å^2 to 2.5 Å^2 over the same range. The companion reaction of H_3^+ giving H_2^+ has a cross section varying from 0.5 Å^2 at 5 keV to 1.6 Å^2 at 35 keV. Corresponding cross sections for vibrationally excited ions are about 0.25 Å^2 higher. The dissociation of H^+ to give H^+ has a cross section of about 1.6 Å^2 over the range 5 to 45 keV. The molecular ion H_5^+ has been obtained from the source. Its dissociation to H^+ with one-fifth the energy has a cross section of 3.2 Å^2 at 20 keV and is independent of source condition. Excited H_3^+ may prove to be useful for transverse injection into a mirror machine.
Author (NSA)

N66-20262# Battelle-Northwest, Richland, Wash. Reactor Physics Section.
KINETICS I. A NEUTRON KINETICS CODE IN FORTRAN IV
Winston W. Little, Jr. Jul. 1965 25 p refs
(Contract AT(45-1)-1830)
(BNWL-111) CFSTI: HC $1.00/MF $0.50

A numerical solution to the lumped parameter kinetics equation is described. The method presented is particularly well-suited for the analysis of prompt critical excursions. In order to make the code useful for practical problems, a simple heat transfer model is attached to the kinetics equations. A FORTRAN IV source deck listing, input information, and a sample problem are given in the appendices.
Author (NSA)

N66-20263# Alberta Univ., Edmonton. Nuclear Research Center.
LEVELS IN Ne^{21} USING THE $O^{18}(\alpha,N\gamma)Ne^{21}$ REACTION TION
J. G. Pronko, W. C. Olsen, and J. T. Sample [1965] 28 p refs
(NP-15363)

The method of triple angular correlations was used to determine the spins of the 0.35, 1.75 and 2.87 MeV levels as well as the multipole mixing ratios of the gamma rays emitted from these states. The $^{18}O(\alpha,n\gamma)^{21}Ne$ reaction was used with the target approximately 20 keV thick at an alpha particle beam energy of 2.50 MeV. At a beam energy of 4.43 MeV the gamma rays from the 0.35 and 1.75 MeV levels were observed and three types of angular correlation experiments performed; neutron–gamma ray angular correlations with the neutron counter at zero degrees, gamma ray angular distributions with the intermediate radiation unobserved, and gamma–gamma angular correlations. These yielded spin assignments of J=5/2 and 7/2 for the 0.35 and 1.75 MeV levels respectively and multipole mixing ratios $\delta_{0.35}=+0.08 \pm 0.02$, $\delta_{1.40}=+0.18 \pm 0.02$, and $\delta_{1.75}=+0.03 \pm 0.04$. The 1.75 MeV level was found to decay 4.6% ±2.0% to the ground state. At a bombarding energy of 5.50 MeV, neutron–gamma ray correlations yielded a spin of J=9/2 as most probable for the 2.87 MeV level with $\delta_{1.12}=+0.12 \pm 0.06$ and $\delta_{2.52}=+0.035 \pm 0.045$. This level was found to decay at least 63% to the 1.75 MeV level. Positive parities are implied for all the levels studied.
Author (NSA)

N66-20266# California Univ., Berkeley. Lawrence Radiation Lab.
A FORTRAN PROGRAM FOR CALCULATING KINEMATICAL AND DYNAMICAL QUANTITIES OF PARTICLE INTERACTIONS AND DECAYS
W. Peter Trower 3 Sep. 1964 3 p ref
(Contract W-7405-ENG-48)
(UCRL-11648) CFSTI: HC $1.00/MF $0.50

The application of special relativity to particle interactions is in general a straighforward but often tedius affair. A computer program is described that calculates relativistic kinematics and dynamics of particle interactions. NSA

N66-20268# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
MULTIPLE π^0 PRODUCTION OF XENON NUCLEI [MNOZHESTVENNOE ROZHDENIE π^0-MEZONOV NA YADRAKH KSENONA]
A. F. Grashin, V. S. Demidov, V. G. Kirillov-Ugryumov, A. K. Ponosov, L. A. Prokhorova et al 1964 15 p refs In RUSSIAN; ENGLISH summary *Its* Rept.-220
(NP-15383)

The multiple π^0 production (two and more in the act of interaction) by 2.8 BeV/c π^- mesons on Xe nuclei was investigated. The cross section for such a process (summed over any other reaction products) was estimated: σ 35 mb. Experimental data indicate more cumbersome reaction mechanism compared with collisions of pions and quasi-free nucleons of nuclei.
Author (NSA)

N66-20271# Oak Ridge National Lab., Tenn. Neutron Physics Div.
PROPAGATION OF NEUTRON WAVES THROUGH HETEROGENEOUS MULTIPLYING AND NONMULTIPLYING MEDIA
V. R. Cain (Ph.D. Thesis–Fla. Univ.) Aug. 1965 110 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1184) CFSTI: HC $4.00/MF $0.75

Prediction of the behavior of neutron waves in heterogeneous media is performed using one-group diffusion theory and age diffusion theory. The one-group theory is used in two different, finite geometries which allow reduction to a one-dimensional problem and to a two-dimensional problem. These cases result in diffusion kernels, or Green's functions, for the two finite configurations. The theory is then extended to include Fermi age, or continuous slowing down, theory for higher energy neutrons. The approach is similar to the Feinberg–Galanin heterogeneous reactor theory except that it is applied to a finite geometry and includes time dependence. A finite diffusion kernel is obtained which is similar to the results of the simpler calculations. In addition, a finite medium, Fermi age kernel results which describes the behavior of the slowing down neutrons in the finite geometry. Both the one-group and the age diffusion developments are used to calculate numerically sample configurations which are suitable for experimental verification. These include rectangular assemblies of graphite and heavy water which have poison or fuel rods inserted. In order to demonstrate better the improvements of this work over the Feinberg–Galanin theory, an extension to critical assemblies is made. This offers the possibility of doing criticality calculations for physically small assemblies which are not amenable to homogenization techniques. Using the age-diffusion theory results, it is also shown that data from neutron wave experiments may be processed in such a way as to give experimental measurements of both the diffusion and the slowing down kernel. Author (NSA)

N66-20276# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Theoreticheskoi i Eksperimental'noi Fiziki.

A SCHEME OF MULTIPLICATION OF SU_3–REPRESENTATIONS

L. B. Okun 1964 6 p refs *Its* Rept.-275 (NP-15390)

A scheme is presented for decomposing a product of two SU_3 representations into irreducible representations. NSA

N66-20277# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

REAL PART OF THE SPIN-ZERO AMPLITUDE FOR T=0 AND SPIN-DEPENDENT AMPLITUDES OF NUCLEON–NUCLEON FORWARD SCATTERING AT HIGH ENERGIES [O NEISTVITEL'NOI CHASTI BESSPINOYOI AMPLITUDY S T=0 I SPINOZAVISYASHCHIKH AMPLITUDAKH NUKLON–NUKLONNOGO RASSEYANIYA VPERED PRI VYSOKIKH ENERGIYAKH]

V. P. Kabavets 1965 16 p refs In RUSSIAN; ENGLISH summary *Its* Rept.-325 (NP-15452)

On the basis of experimental data on nucleon–nucleon interactions within the framework of isotopic invariance, it is shown that at energies up to 2 or 3 GeV the contribution into the isotopic amplitude A of a state with T=0 is given by the real part of the spinless amplitude Re A or by spin-dependent amplitudes. $|A|^2/|\mathrm{Im}\,A|^2 \geq 1.14 \pm 0.07$ at $E_{kin}=2$ GeV. The value Re A at 2.85 GeV obtained from n-p charge exchange data, assuming negligible contribution of spin-dependent amplitudes, is not unique, and equals either (0.35 ± 0.12) Im A or (-0.8 ± 0.12) Im A. Arguments in favor of the second solution are given. The information about Re A and spin-dependent amplitudes that can be obtained from experiments on elastic n-p scattering is considered. Author (NSA)

N66-20282# Lyon Univ. (France). Faculte des Sciences.

ON THE UTLIZATION OF INDEFINITE METRICS FOR THE DETERMINATION OF PROPAGATORS IN QUANTUM FIELD THEORY [SUR L'UTILISATION DES METRIQUES INDEFINIES POUR LA DETERMINATION DES PROPAGATEURS EN THEORIE QUANTIQUE DES CHAMPS]

Joseph Goldberg (Ph.D. Thesis) [1965] 32 p refs In FRENCH

A Hilbert space of infinite dimension with indefinite metrics is defined. The definition of the unitary representations of the Lorentz group is reviewed. The free fields, described as usual in positive definite metrics, but having an indefinite metrics when the fields are in interaction, are examined. The interaction is calculated using an indefinite metrics and perturbation theory. The second order and higher approximations are presented as functional integrals with their nuclei being constituted by the mean values on the vacuum state of commutators of field operators. It is shown that these mean values can be modified by the metrics used. The hypothesis that the field operator commute with the metric operator is discussed. NSA

N66-20283# California Univ., Berkeley. Lawrence Radiation Lab.

ANGULAR DISTRIBUTIONS FOR $\pi^- p \rightarrow \pi^0$ AT 315 AND 371 MeV

Richard J. Kurz and Don L. Lind 6 Jul. 1964 11 p refs (Contract W-7405-ENG-48) (UCRL-11548) CFSTI: HC $1.00/MF $0.50

An analysis of the angular distribution of the reaction $\pi^- p \rightarrow \pi^0 n$ incorporating four classes of data is reported. They are: (a) previously published γ-angular distributions at $T_{\pi^-}=317$ and 371 MeV (T_{π^-}=incident π^- kinetic energy); (b) the neutron differential cross section at $T_{\pi^-}=374$ MeV in the range $84 \leq \theta_n^* \leq 133$ deg^2 (θ_n^*=c.m.-system neutron angle=$\pi-\theta^*$o, * denotes c.m.-system variable), (c) neutron differential cross sections at $T_{\pi^-}=313$ and 371 MeV in the range $21 \leq \theta_\pi^* \leq 123$ deg^3; and (d) the differential cross section at θ_π^*o=0 deg calculated from the forward direction, fixed-momentum transfer dispersion relations for pion nucleon scattering. A least squares analysis was performed to fit these data to the c.m.-system differential cross section in the form: $d\sigma/d\Omega^*(\cos\theta_\pi^*\mathrm{o}) = \sum_{\ell=0}^{n} a_\ell P_\ell(\cos\theta_\pi^*\mathrm{o})$. NSA

N66-20284# Stanford Univ., Calif. Stanford Linear Accelerator Center.

APPLICATION OF PROTON RESONANCE TO THE MEASUREMENT OF INHOMOGENEOUS MAGNETIC FIELDS [PRIMENENIYE PROTONNOGO REZONANSA DLYA IZMERENIYA NEODNORODNYKH MAGNITNYKH POLEY]

A. I. Zhernovoy, Yu. S. Egorov, and G. D. Latyshev [1965] 8 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh., Akad. Nauk Belorusskoi SSR (Minsk), v. 1, no. 9, 1958 p 123–127 (SLAC-TRANS-22) CFSTI: HC $1.00/MF $0.50

A description is given of nuclear resonance equipment which makes it possible to use the phenomenon of nutation of the resultant magnetic moment of protons of water for the measurement of inhomogeneous magnetic fields. The choice of optical parameters is considered and accuracy of the measurement is estimated. NSA

N66-20285# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

THE BACKWARD ELASTIC SCATTERING OF PIONS ON NEUTRONS WITHIN THE MOMENTUM RANGE 1.2–4.6 BeV/C

A. I. Alikhanov, G. L. Bayatyan, E. V. Brachman, Yu. V. Galaktionov, F. A. Joch et al 1964 10 p refs Presented at the Dubna Conf. on High Energy Phys., Aug. 1964 *Its* Rept.-279 (NP-15376)

The cross section of $\pi^- + n$ elastic backward scattering was measured. The behavior of the cross section over the 1.2–4.5 BeV/c incident momenta is given. Author (NSA)

N66-20294# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

VERTEX FUNCTION POLES AND ONE-PARTICLE STATES ORTHOGONALIZATION

B. V. Geshkenbein and B. L. Ioffe 1964 7 p refs (NP-15382)

The vertex function $\Gamma(x^2)$ of a spin-zero interaction of three bosons is considered. It is shown that a certain proof that Γ must have a pole in the complex plant is in error. NSA

N66-20296# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

UNITARY SYMMETRY AND K_{e4}-DELAY [UNITARNAYA SIMMETRIYA K_{e4} RASPAD]

V. I. Zakharov 1965 8 p refs In RUSSIAN *Its* Rept.-320 (NP-15239)

A relation between K_{e4} vector interaction coupling and $\eta \to \pi^+ + \pi^- \gamma$ coupling is derived in the limit of complete symmetry. Making use of this relation and experimental data available one can estimate the vector interaction contribution into observable effects in K_{e4} decay. The estimation leads to a considerable "right left" asymmetry. Author (NSA)

N66-20299# Los Alamos Scientific Lab., N. Mex.

A QUANTUM-CORRECTED AND CORRELATION-CORRECTED THOMAS-FERMI-DIRAC EQUATION WITH A FORTRAN CODE

John F. Barnes 28 May 1965 46 p refs (Contract W-7405-ENG-36) (LA-3268) CFSTI: HC $3.00/MF $0.75

Previously, a "quantum correction" to the statistical model of the atom was derived in detail. In the present work these results and a very simple approximation to the correlation energy are used in deriving a quantum- and correlation-corrected Thomas-Fermi-Dirac (TFD) equation. One expects the radial density distribution and potential calculated from this equation to be improved over those on the TFD model, both near the nucleus and near the outer boundary of the atom or ion. Minimum-energy (that is, zero boundary pressure) solutions for rare-gas atoms possess values of cell radius in good agreement with those calculated from experimental values of the lattice parameter. A Fortran code is included. Author (NSA)

N66-20305# United Kingdom Atomic Energy Authority, Harwell (England). Electronics Div.

NEW METHODS OF MEASURING NEUTRON DOSE EQUIVALENT RATE AROUND PULSED NEUTRON GENERATORS

J. W. Leake Jun. 1965 20 p refs (AERE-R-4883) HMSO: 3s

Two methods of measuring neutron Dose Equivalent (DE) around pulsed machines are described. Both methods employ the moderator system of the neutron counter assembly T. 1940A (which is based on the Andersson-Braun counter), with either the standard T. 1940A boron trifluoride pulse counter or a BF_3 ion chamber mounted at the center. The limitations of the T. 1940A with the pulse-type counter and the advantages of the ion chamber version are discussed. It is shown that under favorable conditions the T. 1940A with a pulse-type counter is able to measure pulsed radiation, with less than 2% count loss, up to a mean DE rate of 1 rem/hr. The response of both systems is proportional to DE rate (as recommended by the I.C.R.P. 1963) within ±50% for neutrons of all energies from thermal to 12 Mev. Author (NSA)

N66-20313# California Univ., Livermore. Lawrence Radiation Lab.

COPPER L_{III} SHELL X-RAY PRODUCTION BY 25–100 KeV PROTONS

D. L. Potter, J. M. Khan, and R. D. Worley 16 Jun. 1964 13 p refs (Contract W-7405-ENG-48) (UCRL-7813) CFSTI: HC $1.00/MF $0.50

Recent X-ray production studies of L-shell X-rays from copper by proton bombardment (100–500 kev) were extended to 25-kev energy. In the region of the periodic table near copper the higher intensity ($L_{\beta 1}$, $L_{\beta 3,4}$) characteristic X-ray lines from the L_I and L_{II} shells are absorbed in the L_{III} shell. By using thin copper absorber foils the characteristic X-rays from the L_{III} shell of copper were isolated from the L_I and L_{II} characteristic X-rays. The thick target yields of both groups are presented as well as the X-ray production cross section for the L_{III} shell ionization cross section decreases from 3.6×10^{-22} cm^2 at 100 kev to 2.3×10^{-24} cm^2 at 25 kev. The $L_{III}/L_I + L_{II}$ X-ray intensity ratio decreases from 1.4 at 100 kev to an extrapolated value of approximately 1 at zero proton energy. Author (NSA)

N66-20330# Ceskoslovenska Akademie VED, Rez. Ustav Jaderneho Vyzkumu.

POSSIBILITY OF OBTAINING NON-EXCITED COMPOUND NUCLEI OF HEAVY TRANSURANIUM ELEMENTS [O VOZMOZHNOSTI POLUCHENIYA NEVOZBUZHDENNYKH YOSTAVNOKH YADER TYAZHELYKH TRANSURANOVYCH ELEMENTOV]

Jaromir Maly Jun. 1965 23 p refs In RUSSIAN; ENGLISH summary (UJV-1293/65)

The excitation energies $E_B^X = E_B - Q$ of the same compound nucleus, (Z_c, A_c), (in the first approximation) are calculated. This compound nucleus is assumed to be formed by the nuclear reactions of accelerated heavy ions—at several combinations of a target nucleus (Z_2, A_2) with a heavy ion (Z_1, A_1). The calculations are performed for an initial heavy ion energy equal to the energy of the classical Coulomb barrier (E_B) and for increasing (Z_1, A_1) from H_1^1 to $(Z_1, A_1) = [(Z_c, A_c)/2]$. The calculations in the case of compound nuclei of Zr_{40}^{90} or Hf_{72}^{178} show that E_B^X initially grows quickly with increasing (Z_1, A_1) and at large (Z_1, A_1) slowly reaches its maximum value near $(Z_1, A_1) = [(Z_c, A_c/2)]$. On the other hand, a similar calculation of E_B^X performed for the compound nucleus 104^{264}, shows that E_B^X has a maximum at $Z_1 = 10-12$, while at higher (Z_1, A_1) it drops to the zero values and near $(Z_1, A_1) = [(Z_c, A_c)/2]$ has negative values. A similar dependence of E_B^X on the (Z_1, A_1) (with maximum near $Z_1 = 10-14$ and zero or negative values of E_B^X at $(Z_1, A_1) = [(Z_c, A_c)/2]$) appears for all elements from $Z = 100$ to $Z = 116$. For synthesis of heavy elements (Z_c, A_c) with $Z_c \geq 100$, the use of a nuclear reaction reversed to fission of a compound nucleus is proposed: $(Z_1, A_1) + (Z_2, A_2) = (Z_c, A_c)$ where $(Z_1, A_1) = (Z_2, A_2) = [(Z_c, A_c)/2]$ (e.g., $Te_{52}^{130} + Te_{52}^{130} = 104^{260}$ or $Sn_{50}^{124} + Xe_{54}^{136} = 104^{260}$). The calculation of E_B^X for this kind of nuclear synthesis of heavy elements yields the compound nucleus with zero (or near zero) excitation energy. It is supposed that a compound

nucleus with $Z_c \geq 100$ and with zero excitation energy will originate with an order of cross section not far from the well-known cross sections σ_c for compound nucleus formation ($\sigma_c \approx 10^{-26} cm^2$). The error of such calculations of E_B^X is discussed in connection with the errors of calculations of Q (Q=exothermic energy of the reaction of compound nucleus formation) calculated with Seeger tables (6) as well as the errors of calculation of E_B. The magnitude of the maximum error in E_B calculations ($\Delta E_B^X \leq 18$ MeV) in the region of $Z_c \geq 104$ shows that the possibility of obtaining a non-excited compound nucleus remains at $(Z_1, A_1) = [(Z_c, A_c)/2]$, even when the maximum error is added to the calculated E_B^X. Author (NSA)

N66-20344# International Centre for Theoretical Physics, Trieste (Italy).

GENERALIZED SPHERICAL FUNCTIONS FOR THE NON-COMPACT ROTATION GROUPS

J. Fischer, J. Niederle, and R. Raczka Jun. 1965 20 p refs Submitted for Publication

(IC/65/63)

Special representations of arbitrary non-compact rotation groups labelled by one non-vanishing Casimir operator are considered. The explicit construction of the corresponding generalized spherical functions is given and the properties of these representations are discussed in detail.

Author (TAB)

N66-20349# Research Inst. of National Defence, Stockholm (Sweden).

A MONTE CARLO PROCEDURE FOR CALCULATING THE MIGRATION OF PROTONS TAKING ACCOUNT ONLY OF ELECTROMAGNETIC INTERACTIONS

C. Johansson and M. Leimdoerfer Jan. 1965 18 p refs

(NP-15163)

A method is described for investigating the penetration and slowing-down of protons due to proton–atom interactions of non-nuclear type. A "continuous slowing-down" model was applied which moves the protons down in energy between a set of predefined energy points. A sample result shows the expected energy distribution of 187 Mev protons after penetrating aluminum slabs of various thicknesses.

Author (NSA)

N66-20353# Oak Ridge National Lab., Tenn.

SPACETIME AND ELEMENTARY PARTICLE GROUPS

M. A. Melvin and R. Roskies [1965] 14 p refs Presented at 2d Topical Conf. on Resonant Particles, Athens, Ohio

(Contract W-7405-ENG-26)

(ORNL-P-1386; CONF-650619-1) CFSTI: HC $1.00/MF $0.50

The possibilities of deriving mass-splitting formulas from a conjectured coupling of the spacetime symmetry associated with isolated particles, with their approximate internal symmetry are discussed. Theory of the hydrogenic spectrum is used to illustrate the extent to which one might expect to find mass-splitting formulas by guessing a group of higher symmetry in which manifest symmetries are embedded. Problems are discussed which arise if mass splitting may be interpreted in terms of the existence of a supersymmetry group G within which space-time and internal symmetries are coupled nontrivally, i.e., if G does not contain the mass-determining spacetime group as a direct product factor. Indications are that barring a possible radical redefinition of mass, the explanation of mass splitting is not to be found by embedding the Poincaré group into a finite parameter Lie group G. Author (NSA)

N66-20358# Oak Ridge National Lab., Tenn.

A SURVEY OF E1 TRANSITIONS IN THE RARE-EARTH REGION

W. B. Ewbank [1965] 13 p refs Presented at Intern. Conf. on the Internal Conversion Processes, Nashville, Tenn., 10-13 May 1965

(Contract W-7405-ENG-26)

(ORNL-P-1256; CONF-650525-3) CFSTI: HC $1.00/MF $0.5(

A review of the lifetimes and conversion properties of all predominantly E1 transitions in rare-earth nuclei confirmed the correlation between the γ-ray hindrance and the observed anomalies in internal-conversion coefficients. It is shown that the anomalies occur only in those transitions for which internal conversion is allowed by the interaction of orbital electrons with the nucleon spin-current inside the nucleus. The cofficients for conversion of a transition in the K shell and in the L_1, L_2 subshells are shown to be increased by about the same factor over their theoretical values. Author (NSA)

N66-20360# Oak Ridge National Lab., Tenn.

THE NUCLEON-MESON CASCADE INITIATED BY 200-GeV PROTONS

R. G. Alsmiller, Jr. and J. Barish 3 May 1965 19 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1121) CFSTI: HC $1.00/MF $0.50

One-dimensional nucleon-meson cascade calculations were carried out for the case of 200-GeV protons in iron. Since there is very little information concerning particle production at such high energies, two calculations using different assumptions about this production were performed.

Author (NSA)

N66-20376# Brookhaven National Lab., Upton, N. Y.

OPTICAL MODEL ANALYSIS OF ELASTIC AND INELASTIC SCATTERING OF NEUTRONS BY ALUMINUM IN THE MeV REGION

S. O. Moore Jun. 1965 13 p refs

(Contract AT(30-2)-GEN-16)

(BNL-927) CFSTI: HC $1.00/MF $0.50

Elastic and inelastic scattering of neutrons on ^{27}Al, a light-mass deformed nucleus, was studied for neutrons from 1 to 5 Mev, using a spherical optical-model potential. The Hauser-Feshbach formalism with transmission coefficients determined for a complex, spin-dependent, diffuse-edge potential with surface absorption is used in the calculation. Selection of the experimental data and handling of the data are discussed. Total and differential elastic cross section data were first considered, and best-fit parameters were found and used to calculate the inelastic scattering cross sections and to obtain parameters consistent with both elastic and inelastic scattering data. Results are given for total, differential elastic and inelastic, and integral inelastic cross sections. NSA

N66-20378 California Univ., Livermore. Lawrence Radiation Lab.

FOTRAC: A MONTE CARLO PHOTON TRACING COMPUTER PROGRAM

Nan Davies and John Terrall 20 May 1965 9 p

(Contract W-7405-ENG-48)

(UCRL-14165)) CFSTI: HC $1.00/MF $0.50

FOTRAC is a computer program for performing transport calculations on photons using the Monte Carlo method. It was originally conceived as part of a larger scheme in which neutrons, transporting themselves through a configuration of media, produced photons from nuclear reactions. As development proceeded it was decided that, in addition to this source of photons, it would be convenient to provide FOTRAC with its

own source generator so that it could function independently as a complete program, as well as in association with the neutron transport calculation. Results from the photon calculation are produced in the form of tables and graphs, with the standard deviations included in both forms. The graphs show crosses which indicate energy spreads as well as the statistical deviations. Author (NSA)

N66-20384# California Univ., Livermore. Lawrence Radiation Lab.

THE SULFIDES OF STRONTIUM, CALCIUM AND MAGNESIUM IN INFRARED STIMULATED LUMINESCENCE DOSIMETRY

E. N. Sanborn and E. L. Beard 9 Jun. 1965 17 p refs Presented at the Intern. Conf. on Luminescent Dosimetry, Palo Alto, Calif.

(Contract W-7405-ENG-48)

(UCRL-12371; CONF-650637-2) CFSTI: HC $1.00/MF $0.50

A study was made of Ca, Mg, and Sr sulfides doped with Eu and Sm for gamma dosimetry using infrared-stimulated luminescence. The sulfides were prepared by reduction of the sulfates, and the optimum Eu and Sm concentration was found to be $3.17\times10-4$ mole fraction of each. The optimum infrared wavelength and the luminescence spectrum were determined for each sulfide. Emission decay, energy output, and shelf life were studied. It is concluded that MgS is the best material, but that its packaging is still a major problem. NSA

N66-20387# Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire.

SEARCH FOR AN EXCITED ELECTRON OF MASS IN THE RANGE OF SEVERAL HUNDRED MeV

C. Betourne, H. Nguyen Ngoc, J. Perez Y Jorba, and J. Tran Thanh Van May 1965 7 p refs

(LAL-1137)

A search was performed for the heavy electron (e'), suggested by Low to explain deviations from simple quantum electrodynamics in electron photoproduction. The observation of the recoil proton in the reaction $e+p\rightarrow p+e'$, $e'\rightarrow e+\gamma$, should reveal the e' as a sharp-missing mass peak in the excitation curve. An attempt was made to detect the e' or to put an upper limit on the coupling (λ) in the range 120 to 570 Mev, using the maximum angle technique and ordinary excitation technique and initial energies from 280 to 980 Mev. No effect was found within the criteria chosen for the existence of a significant enhancement; a lower limit of the quantity $\lambda^{-2}=\sigma_{theor}(\lambda=1)/\sigma_{expt}$ as a function of the mass for the two techniques is given. NSA

N66-20389# California Univ., Livermore. Lawrence Radiation Lab.

UNITARITY CORRECTIONS TO PERIPHERAL P–P SCATTERING BELOW 400 MeV

Richard Allen Arndt (Ph.D. Thesis) 1 Jan. 1965 86 p refs

(Contract W-7405-ENG-48)

(UCRL-12211-T) CFSTI: HC $2.00/MF $0.75

Proton–proton partial wave amplitudes for $1\geq 1$ and lab kinetic energies below 400 Mev are fit with a collection of single-particle exchanges taken in Born (fixed-pole) approximation. Since the Born terms are real, and consequently nonunitary, a correction term is added which makes the full amplitude unitary and at the same time satisfies the appropriate dispersion relation and threshold condition. The nature of this correction term and its association with a strip approximation to the Mandelstam representation is discussed. The gross structure of the partial wave amplitudes is found to be approximately given by a π meson ($J=0^+$, $T=1$, $g_\pi^2\sim13.5$, $M_\pi\sim135$ Mev), an S_0 meson ($J=0^+$, $T=0$, $g_{S_0}^2\sim1.8$, $M_{S_0}\sim400$ Mev), and an effective vector meson ($\rho+\omega$ effect) ($g_V^2\sim1.7$, $(f/g)_V\sim3$; $M_V\sim760$ Mev). It is further found that the relatively small unitarizing corrections play an essential role in determining the goodness of fit, but do not much alter the pole parameters determined from search. Author (NSA)

N66-20399# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

SOME QUESTIONS ON THE THEORY OF WEAK INTERACTION [NEKOTORYE VOPROSY TEORII SLABOGO VZAINODEISTVIYA]

E. P. Shabalin (Thesis) 1965 108 p refs In RUSSIAN

(NP-15199)

In the Sakata model the fundamental particles are assumed to be the proton (p), neutron (n), the Λ-hyperon, and their antiparticles. The π-meson and K^+-meson with a strangeness $S=1$ are bound states. In the Sakata model lepton decays of π-meson and K-mesons should be considered as an annihilation transfer of a bound state to a corresponding lepton pair. Three rules for lepton decays taking place with a change in strangeness are: $|\Delta S|=1$, $\Delta Q=\Delta S$, and $\Delta T=1/2$. The discovery of $K_{e\nu}$ and $K_{\mu\nu}$ decays, in which K-mesons decay to two π-mesons and a pair of leptons (electron neutrinos or muon neutrinos) would be of interest in verifying the Sakata model. If the rule $\Delta Q=\Delta S$ is valid, the following decays should exist: (1) $K^+\rightarrow\pi^++\pi^-+e^++\nu$, and (2) $K^+\rightarrow\pi^0+\pi^0+e^++\nu$. The energy spectrum of the electrons and of the π-mesons, the angular π-e correlation and the probabilities of the $K_{e\nu}$ and $K_{\mu\nu}$ decays are derived. The cross section for the creation of a lepton pair of neutrinos is calculated for neutrino scattering in the Coulomb field of the nucleus for the process: $\nu+Z\rightarrow\nu'+Z+\mu^+(e^+)+\mu^-(e^-)$. At an energy of 2 Bev the cross section for the creation of electron pairs is a factor of 100 greater than that involving the creation of muon pairs, and attains a value of 8×10^{-41} cm^2 (in lead). It is shown that the reaction $\gamma+\gamma\rightarrow\gamma+\nu+\bar{\nu}$ is not an important source of neutrinos in stars having a temperature of $\sim10^9$ degrees Kelvin and a density of $\sim10^6$ g/cm^3. NSA

N66-20400# Oak Ridge National Lab., Tenn.

$^{51}V(p,n)^{51}Cr$ CROSS SECTION FROM THRESHOLD TO 2.25 MeV

J. H. Gibbons and R. L. Macklin [1965] 6 p refs Presented at the 2nd Intern. Meeting on Accelerator Targets Designed for the Production of Neutrons, Grenoble, France, 21–22 Jun. 1965

(Contract W-7405-ENG-26)

(ORNL-P-1468; CONF-650635-1) CFSTI: HC $1.00/MF $0.50

The absolute (p,n) total cross section for $^{51}V(p,n)$ was measured from threshold to 2.25 MeV with an accuracy of 5%. The cross section measured with an $\sim$15 kev thick target fluctuates appreciably despite the $\sim$1 kev level spacing observed using a thin target. The small change of neutron energy with emission angle makes this reaction a good 4π monoenergetic source. Author (NSA)

N66-20403# Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire.

ON THE INELASTIC ELECTRON-DEUTERON SCATTERING AND THE RESCATTERING CORRECTIONS

B. Bosco, B. Grossetete, and P. Quarati Apr. 1965 45 p refs Sponsored in part by AFOSR Prepared in cooperation with Cagliari Univ., Turin, Italy
(LAL-1131)

Inelastic electron-deuteron scattering is examined on the basis of the recent Orsay experiments. The expression for the differential cross section is derived on a general basis. The rescattering corrections predicted by different methods are compared extensively, and their effects on the nucleon form factors discussed. Author (NSA)

N66-20404# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
"COLLECTIVE" LEVELS IN DEFORMED NUCLEI WITH ODD A IN THE RARE-EARTH REGION ["KOLLEKTIVNYE" UROVNI V DEFORMIROVANNYKH YADRAKH S NECHETNYM A V OBLASTI REDKOZEMEL'NYKH ELEMENTOV]
V. Gnatovich and K. Gromov 1965 12 p refs In RUSSIAN
(JINR-P-2086)

A review is given of the experimental data on the collective levels in the deformed nuclei with odd A in the rare-earth region. Author (NSA)

N66-20406# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
NUCLEAR REACTIONS ON Ir, Ta, AND Er INDUCED BY PROTONS OF ENERGY UP TO 85 MeV [YADERNYE REAKTSII NA Ir, Ta, I Er, VYZVANNYE PROTONAMI S ENERGIEI DO 85 MeV]
V. S. Barashenkov, V. M. Mal'tsev, and T. D. Toneev 1965 6 p refs
(JINR-P-1978)

The relative contribution is investigated of nucleon-nucleus interactions involving the formation of a compound nucleus and of interactions in which the intranuclear cascade is developed and a subsequent evaporation of particles from the residual nucleus occurs. As an example, the proton interaction with Ir, Ta, and Er nuclei at 20 to 80 MeV is considered. Author

N66-20409# European Atomic Energy Community, Brussels (Belgium).
THE CORRECTION FOR FOIL ABSORPTION IN 4 π-COUNTING
W. van der Eijk 1965 31 p refs
(EUR-2248.e)

Experimentally determined corrections for the foil absorption in 4π counting are presented for several radionuclides in current use. A discussion of the precision and the limits of applicability as well as a short discussion of the theoretical aspects of the problem are included. Author

N66-20413# Los Alamos Scientific Lab., N. Mex.
CHARGED BOND CORRECTION TO THE DISPERSION CURVES OF DIAMOND
John L. Warren [1965] 14 p refs Presented at the Symp. on the Inelastic Scattering of Neutrons by Condensed Systems, Upton, N. Y., 20-22 Sep., 1965
(Contract W-7405-ENG-36)
(LA-DC-7277; CONF-650932-2) CFSTI: HC $1.00/MF $0.50

In an attempt to find a model for the phonon dispersion curves for diamond, it was noted that the charge-density about any atom in a diamond-type lattice is not spherically symmetric. An electrostatic model for the lowest order of approximation was derived. The formulas for the second neighbor Born-von Karman model which forms the basis of the included short range interaction are summarized. The calculation of the electrostatic contribution to the dynamical model is described. Conclusions from the calculation are given. M.O.W.

N66-20418# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
THE CAPTURE OF μ^- MESONS BY LIGHT NUCLEI [ZAKHVAT μ^--MESONOV LEGKIMI YADRAMI]
G. Ya Korenman and R. A. Eramzhyan 1965 8 p ref In RUSSIAN
(JINR-P-2063)

The probability of the π^--meson capture from a definite state of the hyperfine structure of a mesic atom is investigated. It is shown that in the case of ^{13}C and ^{19}F, the probability of the capture from the lower state of the hyperfine structure depends only on G^2. Author

N66-20423# Nuclear Materials and Equipment Corp., Apollo, Pa.
DATA PACKAGE FOR NUMEC'S IRRADIATION TESTING PROGRAM. CAPSULES NU-17, NU-18, AND NU-19
8 Feb. 1965 101 p refs
(Contract AT(30-1)-3432)
(NUMEC-3432-7) CFSTI: HC $4.00/MF $1.00

The data required for the long-term irradiation of UO_2-PuO_2 in capsules NU-17, NU-18, and NU-19 are presented. They include: equipment, flux requirements, heat production, temperatures, fission gas pressure, heat transfer calculations, fabrication, hazards, alarms, etc. D.L.C.

N66-20427# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy and Lab. of Theoretical Physics.
ELECTROMAGNETIC DECAYS AND MASS SPLITTING OF VECTOR MESONS IN UNITARY SYMMETRY
Dao Wong Duc and Nguyen Van Hieu 1965 7 p refs In RUSSIAN Repr. from Nadernaya Fyzika (USSR)
(JINR-P-1974)

A possibility of determining the renormalization mass constant of the unitary octuplet of vector mesons is treated on the basis of a study of the neutral vector meson decays into the $\mu^+\mu^-$, e^+e^- pairs. Author (NSA)

N66-20448# Brookhaven National Lab., Upton, N. Y. Cosmotron Div.
ISOTOPIC SPIN (SU_2) AND THE EIGHT-FOLD WAY (SU_3) FROM AN ELEMENTARY VIEWPOINT
Robert K. Adair (Yale Univ.) Jul. 1965 38 p
(Contract AT(30-2)-GEN-16)
(BNL-9364) CFSTI: HC $2.00/MF $0.50

Separate sections on symmetry are discussed from an elementary viewpoint. The discussion concerns: the neutron-proton symmetry, SU_2 and the elementary particles, the eight-fold way, SU_3, and the consequences of SU_3. NSA

N66-20450# Case Inst. of Tech., Cleveland, Ohio.
A NEW MEASUREMENT OF THE REACTION $\bar{\nu}_e+p \rightarrow \beta^+ + n$
F. Reines and F. A. Nezrick [1965] 7 p Presented at Informal Conf. on Exptl. Neutrino Phys., Geneva, 20 Jan. 1965
(Contract AT(11-1)-818)
(COO-818-65; CONF-650111-8) CFSTI: HC $1.00/MF $0.50

The reaction $\bar{\nu}_e+p \rightarrow \beta^+ + n$ was studied with extremely small equipment. The measured positron spectrum is presented. This was used to deduce by phase space and conservation arguments the antineutrino spectrum from fission. The results are presented. NSA

N66-20451# Brookhaven National Lab., Upton, N. Y.
A NOTE ON THE COMPOSITENESS CONDITION IN POTENTIAL THEORY
R. M. Rockmore Jul. 1964 7 p refs Work Done at Lawrence Radiation Lab., Calif. Univ., Berkeley Prepared in Cooperation with Rutgers Univ.
(Contract AT(30-2)-GEN-16; Grant NSF G-24822)
(BNL-8245) CFSTI: HC $1.00/MF $0.50

A brief discussion is given of the graphical properties of the mapping problems associated with the Mandelstam representation for s-wave potential scattering with one bound state. The consistency condition on the bound state residue (Z_3=0) is used to put the result of Blankenbecler et al. into obvious Lehmann form. Author (NSA)

N66-20452# European Atomic Energy Community, Brussels (Belgium). European Scientific Data Processing Center.
NUMERICAL SOLUTION OF THE INTEGRAL TRANSPORT EQUATION IN APPROXIMATION TO ONE VELOCITY AND ISOTROPIC SCATTERING IN PLANE AND CYLINDRICAL SYMMETRY [RISOLUZIONE NUMERICA DELL' EQUAZIONE INTEGRALE DEL TRANSPORTO NELLA APPROSSIMAZIONE AD UNA VELOCITA' E SCATTERING ISOTROPO IN SIMMETRIA PIANA E CILINDRICA]
A. Inzaghi, B. Montagnini, and T. Pomentale (Milan Univ.) 1965 110 p refs In ITALIAN
(EUR-2410.i)

The code solves the one velocity integral transport equation, under the assumption of isotropic scattering, in plane and cylindrical geometry. Homogeneous (eigenvalue) and nonhomogeneous problems are considered. The difficulties which are usually encountered when it is sought to introduce the reflection boundary condition (of standard use in lattice cell calculations) in an integral formulation of the transport equation are eliminated by representing the angular density of the neutrons entering the cell from the neighboring ones by means of a rapidly converging spherical harmonics expansion. Author (NSA)

N66-20460# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
PHOTON AND NOTOPH [FOTON I NOTOF]
V. I. Ogievetskii and I. V. Polubarinov 1965 9 p refs In RUSSIAN
(JINR-P-2330)

In contrast to the case of massive particles, for massless particles the spin component in the direction of the spatial momentum (helicity) is relativistically invariant. The massless particle with helicity 0, the properties of which are complementary to those of the photon (helicity ±1) and which is therefore named notoph, is discussed. The interacting notoph has spin 1 like the photon. The notoph is described by the antisymmetric tensor-potential, and the field 4-vector serves as the field intensity of the notoph (instead of the vector-potential and the intensity tensor in the case of electromagnetic field). Zero-zero transitions with the emission of the notoph are allowed. Author (NSA)

N66-20462# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON A COMPOSITE MODEL OF MESONS ON THE BASIS OF THE BETHE-SALPETER TYPE EQUATIONS [O SOSTAVNOI MODELI MEZONOV NA OSNOVE URAVNENII TIPA BETA-SOLPITERA]
P. N. Bogolyubov 6 Apr. 1965 14 p refs In RUSSIAN
(JINR-P-2098)

The quark-antiquark system was considered on the basis of the Bethe-Salpeter type equations. An equation was obtained which allows one to determine the electric and magnetic form factors of mesons. Author (NSA)

N66-20463# Michigan Univ., Ann Arbor.
ON CERTAIN COMMON APPROXIMATIONS IN THERMAL NEUTRON SCATTERING
John Paul Plummer (Ph.D. Thesis) 1964 154 p refs
(Contract AT(11-1)-917)
(COO-917-15) CFSTI: HC $5.00/MF $1.00

Approximations noramally made in thermal neutron scattering are considered. Separate chapters were devoted to the following: neutron scattering from an ideal classical gas—the Wigner-Wilkins kernel, neutron scattering from an ideal quantum gas—Van Hove's correlation functions, calculations of interference effects in neutron scattering from an ideal quantum gas, multiple scattering corrections to the Fermi approximation, in the static approximation, and chemical binding corrections to the Fermi approximation. A discussion of results follows. NSA

N66-20465# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
A GENERAL SOLUTION OF CHEW-LOW EQUATION AND THE DEPENDENCE OF SCATTERING PHASES ON THE ISOTOPIC SPIN [OBSHCHII VID RESHENIYA URAVNENII CHU-LOU I ZAVISIMOST S-FAZ π-N RASSEYANIYA OT IZOTOPICHESKOGO SPINA]
V. A. Meshcheryakov 1965 15 p refs In RUSSIAN
(JINR-P-1964)

General solutions of Chew-Low equations are found for S, P, D...partial waves. The multiplicity of these solutions is established. It is shown that the strong dependence of S phases of πN scattering on the magnitude of the total isotopic spin of the πN system can be understood in the framework of unitarity and crossing symmetry. Author (NSA)

N66-20467# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ELECTROMAGNETIC TRANSITIONS IN ODD-MASS NON-AXIAL NUCLEI [ELEKTROMAGNITNYE PEREKHODY V NECHETNYKH NEAKSIAL'NYKH YADRAKH]
V. V. Pashkevich 12 Feb. 1965 23 p refs In RUSSIAN
(JINR-P-2003)

Electromagnetic transitions in odd nuclei are considered, using a model in which the nucleus is represented by a non-axial core and an external nucleon whose moment is conserved. The calculation is carried out without using the adiabatic approximation, i.e., without differentiating between single-particle and collective motions. The results are compared with experimental data. Author (NSA)

N66-20468# Brown Univ., Providence, R. I. High Energy Physics Group.
ELASTIC SCATTERING OF NEGATIVE PIONS BY PROTONS AT 903 MeV
Merlin Gene Taylor (M.S. Thesis) Jun. 1965 58 p refs *Its* Internal Rept.-108
(Contract AT(30-1)-2262)
(NYO-2262-86) CFSTI: HC $3.00/MF $0.75

The meson (π^-) proton interaction was investigated at 903 MeV using a hydrogen bubble chamber. The measuring techniques and event construction and selection are discussed. The elastic scattering cross sections and angular distributions were determined. NSA

N66-20472# California Univ., Berkeley. Lawrence Radiation Lab.

EFFECTS OF COLLECTIVE EXCITED STATES ON ALPHA PARTICLE BARRIER PENETRABILITY

Elizabeth A. Rauscher (M.S. Thesis) 5 Jan. 1965 50 p refs
(Contract W-7405-ENG-48)
(UCRL-11875) CFSTI: HC $2.00/MF $0.50

For the alpha decay of ^{212}Po to the ground state and various excited states of the ^{208}Pb daughter, there are collective surface vibrational modes, which couple these low-lying excited states to the ground state of ^{208}Pb. In this description of the transitions between these excited states of ^{208}Pb and the ground state of ^{208}Pb only single phonon excitations are considered. Interaction of the electric multipole nature occurs between the excited state levels and the ground state of the recoil lead daughter induced by its interaction with the emitted alpha particle, affecting the latter's penetration of the nuclear barrier. The formation of the excitation in the lead nucleus can either be produced by ^{212}Po alpha decay or by (α,α) inelastic scattering on ^{208}Pb, but in either case it is considered that an alpha cluster exists in the nuclear surface region. The manner in which the multipole interaction affects the alpha particle penetration of the nuclear barrier is investigated. Author (NSA)

N66-20474# Sydney Univ. (Australia). School of Physics.

EXCITATION OF H-ATOMS BY PROTON IMPACT AND BY FAST ATOM IMPACT

Robert M. May Jan. 1965 8 p refs
(TR-15; NP-14859)

Expressions are derived for the cross sections for excitation of hydrogen atoms by proton and fast atom impact. Results are tabulated for proton energies from 1.6 to 200 kev and hydrogen atom energies from 1.6 to 100 kev. (NSA)

N66-20487# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

NUCLEAR FORM-FACTORS IN MUON-CAPTURE BY HELIUM 3 [O YADERNYKH FORMFAKTORAKH PROTSESSE ZAKHVATA MYUONOV GELIEM-3]

O. A. Zaimidoroga, B. V. Struminskii, R. M. Sulyaev, I. V. Falomkin, V. M. Tsulko-Sitinkov et al 1965 7 p refs In RUSSIAN
(JINR-P-1952)

The $\mu^- + {}^3He \rightarrow {}^3H + \nu$ reaction rate (Λ) has been calculated on the basis of data on form-factors obtained in experiments on pion capture by ^3He and the scattering of electrons on ^3He and ^3H. Its value turned out to be 1515 ± 55 sec^{-1} with $g_A^a / g_V^a = -1.16$ and $g_P^\mu / g_A^\mu = 7$. From the comparison of experimental and theoretical results, the pseudoscalar constant $g_P^\mu = (8 \pm 3) g_A^\mu$ has been evaluated. Author (NSA)

N66-20493# Los Alamos Scientific Lab., N. Mex.

FISSION FRAGMENT REMOVAL OF URANIUM FROM A FISSIONING SURFACE

P. J. Peterson and M. M. Thorpe 10 Sep. 1965 21 p refs
(Contract W-7405-ENG-36)
(LA-3352-MS) CFSTI: HC $2.00/MF $0.50

A model is proposed whereby U is removed from a fissioning U metal source by deposition of fission fragment energy in UO_2 crystallites of a critical size range on the source surface. It is also suggested that a second method of U removal is also operative. This concept is represented by the equation $M' = M_o(1 - e^{-\lambda' (\phi t)}) + c'(\phi t)$, where M' is micrograms of U removed, M_o is micrograms of U originally present in UO_2 crystallites of a certain size, λ' is a calculated removal constant for UO_2 crystallites of a given size, and ϕt is the integrated thermal neutron flux seen by the source. The term $c'(\phi t)$ represents the second method of removal where the amount removed per unit of ϕt is the constant, c'. This curve is fitted to data gathered in a series of irradiation capsule experiments. Author (NSA)

N66-20496# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ASYMPTOTIC AND THRESHOLD VALUES OF THE SCATTERING AMPLITUDES OF SOME STATIC MODELS [OB ASIMPTOTICHESKIKH I POROGOVSKH ZNACHENIYAKH AMPLITUD RASSEYANIYA V NEKOTORYKH STATICHESKIKH MODELYAKH]

B. Vit 1965 11 p refs In RUSSIAN Submitted for Publication
JINR-P-2021)

The Phragmen-Lindelöf theorem is used to investigate the asymptotic behavior of the scattering amplitudes for the neutral pseudoscalar static model and the Chew-Low theory. Some information about the threshold and asymptotic values of the amplitudes is obtained with the aid of the argument principle. Author (NSA)

N66-20504# European Organization for Nuclear Research, Geneva (Switzerland). Institute of Theoretical and Experimental Physics.

POSSIBLE CP VIOLATION AND THE NATURE OF THE $\Delta T = 1/2$ RULE

V. Ya. Zel'dovich and L. B. Okun [1965] 6 p refs Transl. into ENGLISH from Phys. Letters (Amsterdam), V. 16, 1965 p 319
(ITEF-343; NP-TR-1282) CFSTI: HC $1.00/MF $0.50

The Wolfenstein model is discussed, in which the $K_2^0 \rightarrow 2\pi$ decay is due to the difference in phase of the primary non-leptonic interaction and of the non-leptonic interaction that appears in the second order of perturbation theory due to the virtual lepton exchange. It is shown that in order to get an observable scale of CP violation it is necessary in this model to abandon the non-leptonic interaction Lagrangian in the form of the product of charged currents. This suggests that the primary non-leptonic Lagrangian satisfies the strict $\Delta T = 1/2$ rule. Author (NSA)

N66-20505# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Fiziko-Energeticheskii Institut.

ON THE POSSIBILITY OF USING NUCLEAR REACTOR IN COSMIC SPACE FOR MEASURING CROSS SECTIONS OF N-N SCATTERING, NO. 7 [O VOZMOZHNOSTI ISPOL'ZOVANIYA YADERNOGO REAKTORA V KOSMICHESKOGOM PROSTRANSTVE DLYA PRYAMOGO IZMERENIYA SECHENIYA (N-N)-RASSEYANIYA, NO. 7]

I. I. Bondarenko, V. P. Kovalev, and V. G. Zolotukhin 1965 11 p refs In RUSSIAN
(NP-15478)

An evaluation of an experiment on the direct measurement of the cross section of n-n scattering in the S-state is presented. It is proposed that a pulsed nuclear reactor with negative temperature coefficient, introduced into cosmic space at a height of 400 to 500 km, be used for the cross-section measurement. It is shown that the n-n scattering length can be measured with an error of $\pm 10\%$. Author (NSA)

N66-20520# Joint Inst. for Nuclear Research, Dubna (USSR).

WEAKENING OF HIGH ENERGY μ BEAMS IN SHIELDING [OSLABLENIE PUCHKOV μ-MEZONOV VYSOKIKH ENERGII V ZASHCHITE]

B. S. Sychev and A. P. Cherevatenko 1965 9 p refs In RUSSIAN
(JINR-P-2354)

Ionization energy losses of muons in different types of concrete are calculated. A method is suggested to calculate a shield form for a filament-like muon beam. Author (NSA)

N66-20521# Los Alamos Scientific Lab., N. Mex.
DESIGN OF A SOURCE OF NEGATIVE POLARIZED HYDROGEN IONS USING CHARGE EXCHANGE IN CESIUM AND ARGON
J. L. Mc Kibben [1965] 5 p refs Presented at Intern. Conf. on Polarization Phenomena of Nucleons, Karlsruhe, W. Germany, 6–10 Sep. 1965
(Contract W-7405-ENG-36)
(LA-DC-7268; CONF-650928-8) CFSTI: HC $1.00/MF $0.50

The use of the metastable state in hydrogen as a means of producing a beam of polarized ions is briefly discussed. Based on the concept of charge exchange in argon and cesium, an apparatus was designed which will produce a relatively large intensity of polarized negative hydrogen ions. A discussion on the operation of the equipment is presented. NSA

N66-20522# Los Alamos Scientific Lab., N. Mex.
ELASTIC SCATTERING OF POLARIZED NUCLEONS
Louis Rosen 1965 52 p refs Presented at Intern. Conf. on Polarization Phenomena of Nucleons, Karlsruhe, W. Germany, 6–10 Sep. 1965
(Contract W-7405-ENG-36)
(LA-DC-7386; CONF-650928-9) CFSTI: HC $3.00/MF $0.50

Los Alamos work with polarized protons is discussed. A survey of work done at other laboratories in the general domain of elastic scattering of polarized protons and neutrons from complex nuclei and for energies below 50 Mev is presented. Extensive data comparisons to the predictions of an optical model potential which were determined from polarized proton data at 10.5 and 14.5 Mev are included. NSA

N66-20523# Oak Ridge National Lab., Tenn.
EXPLORATORY EXPERIMENTS CONCERNING THE DESORPTION OF GASES BY BOMBARDMENT WITH ELECTRONS
R. E. Clausing 3 Nov. 1965 34 p refs Submitted for Publication
(Contract W-7405-ENG-26)
(ORNL-TM-1166) CFSTI: HC $2.00/MF $0.50

Electron bombardment of metal surfaces was investigated as an aid to the degassing of vacuum systems. The amount of gas released depended on the nature of the surface and the energy of the electrons, but the composition was insensitive to the electron energy. When a surface was bombarded for the first time with electrons of energy greater than 20 kev, a brief period of very efficient desorption occurred; the source of this gas was not renewed during several days without bombardment but with vacuum maintained. Electron bombardment is particularly effective for removing organic contamination from surfaces. Also, it is useful for monitoring thermal degassing. Author (NSA)

N66-20524# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
AN EXPERIMENTAL DETERMINATION OF THE $K_2^0 \to 2\pi$ DECAY PROBABILITY IN A SLOPED K_2^0 BEAM [EKSPERIMENTAL'NOE OPREDELENIE VEROYATNOSTI RASPADA $K_2^0 \to 2\pi$ V NAKLONNOM PUCHKE K_2^0-MESONOV]
D. Nyagu, E. O. Okonov, N. I. Petrov, V. A. Rusakov, G. G. Takhtamyshev et al 1965 7 p refs In RUSSIAN
(JINR-P-2325)

It is found that in the sloped and horizontal K_2^0 beams the magnitude of $K_2^0 \to 2\pi$ decay probability is the same within the experimental error. The result obtained shows that the gravitational masses of the K^0 and $\bar{K}^0$ have identical signs. Author (NSA)

N66-20525# Oak Ridge National Lab., Tenn.
ELASTIC AND INELASTIC SCATTERING OF 12.0-MeV PROTONS FROM ^{62}Ni, ^{63}Cu AND ^{64}Zn: TABULATED DIFFERENTIAL CROSS SECTIONS
J. K. Dickens and R. J. Silva Sep. 1965 38 p ref
(Contract W-7405-ENG-26)
(ORNL-3851)

Numerical values of differential cross sections for elastic and inelastic scattering of 12.0-Mev protons from ^{62}Ni, ^{63}Cu, and ^{64}Zn are reported in tabular form. Cross sections were determined at 5° intervals between laboratory angles of 20 and 165° for ^{62}Ni and ^{64}Zn, and between laboratory angles of 20 and 110° for ^{63}Cu. Inelastic-scattering data are reported for 2 excited states of ^{62}Ni (Q = −1.17 and −2.74 Mev); for 17 excited states of ^{63}Cu (Q = −0.668, −0.961, −1.327, −1.412, −1.547, −1.862, −2.012, −2.080, −2.210, −2.337, −2.405, −2.50, −2.69, −3.28, −3.45, −3.69, and −4.11 Mev); and for 21 excited states of ^{64}Zn (Q = −0.993, −1.804, −1.904, −2.31, −2.61, −2.74, −2.79, −3.00, −3.08, −3.20, −3.30, −3.37, −3.45, −3.55, −3.60, −3.71, −3.86, −3.93, −4.03, −4.16, and −4.31 Mev). Author (NSA)

N66-20529# Oak Ridge National Lab., Tenn.
A GENERAL HAUSER-FESHBACH NUCLEAR-SCATTERING COMPUTER PROGRAM
William R. Smith May 1965 16 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1117) CFSTI: HC $1.00/MF $0.50

A CDC-1604 binary program (for which no FORTRAN is available) is described that computes the scattering angular distribution and integrated cross section for any two-particle nuclear reaction, subject only to the restrictions that the spin of one particle in each reaction channel be no greater than 1 and that the maximum number of partial waves necessary in any one channel be no greater than 16. The input required by the program is the charge, mass, spins, parity, and optical-model parameters for all the channels through which the compound nucleus can decay. The calculation makes use of the Hauser-Feshbach theory modified to include spin-orbit coupling. Author (NSA)

N66-20535# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
γ-RAYS OF Tm^{164}. O^+ TYPE LEVEL IN Er^{164} [γ-LUCHI Tm^{164}. UROVEN TIPA O^+ V Er^{164}]
A. S. Basina, T. Bedike, K. Ya. Gromov, B. S. Dzhelepov, V. A. Morozov et al 1965 13 p refs *In* RUSSIAN Repr. from Yadernaya Fyzika (USSR)
(VINR-P-2031)

The relative gamma-ray intensities in ^{164}Tm decay were measured. The values of α_K for some transitions were determined by comparing the gamma-ray intensities with previously obtained K-conversion line intensities. It was established that the 2+ gamma vibrational level in ^{164}Er and the 0+beta vibrational level possess the energies 862 and 1248 keV respectively. Author (NSA)

N66-20537# Tokyo Univ. (Japan). Inst. for Nuclear Study.
AN ANALYSIS OF THE HIGH-ENERGY JET SHOWERS, PART III

T. Borello, M. Cattani, M. Cruz (Sao Paulo Univ.), S. Hasegawa, and N. Yajima et al (Nagoya Univ.) 21 Dec. 1964 59 p refs Sponsored in Part by Conselho Nacl. de Pesquisas de Brazil, Comissao Nacl. de Energ. Atomica, and Fund. de Ampers a Pesquisa do Estado de Sao Paulo
(INSJ-83)

Experimental data to be analyzed are described; about 100 jet showers of the type $N_h=0$ and 1 are chosen by the elementary-process criterion. Results of total energy and angular momentum transferred to secondary mesons, mean energy of secondary mesons, and inelasticities in the ms and the cms are shown as functions of r_c, for incident energy range from $r_c \sim 5$ to ~ 400. Discussions are given of the two-fireball model, the excited baryon model, and the multifireball or H-quanta hypothesis using the relations of physical quantities obtained. NSA

N66-20541# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ISOTOPIC EFFECT IN PHYSICAL ADSORPTION [EFFET ISOTOPIQUE DANS L'ADSORPTION PHYSIQUE]
Pierre Courvoisier Mar. 1965 23 p refs In FRENCH
(CEA-Bib-46)

This literature review covers the period from 1933 to 1962 and includes 31 references. In the first part, are presented the hypotheses, the models, and the calculation methods leading to a determination of the theoretical separation factor in the case of mono- and di-atomic molecules. In the second part, a review is made of the experimental results obtained for the isotopes of hydrogen, neon, nitrogen, and argon; these results are then compared with the theoretical predictions. Author

N66-20547# Oak Ridge National Lab., Tenn.
AEROSOL PHYSICS OF RADIOACTIVE PARTICLES
B. R. Fish and R. L. Walker [1965] 18 p refs Presented at the Intern. Symp. on Fission Product Release and Transport under Accident Conditions, Oak Ridge, Tenn., 5-7 Apr. 1965
(Contract W-7405-ENG-26)
(ORNL-P-1313; CONF-650407-4) CFSTI: HC $1.00/MF $0.50

The extent to which the behavior of radioactive aerosols differs from that of nonradioactive aerosols has not been clearly established. Such information is potentially of importance with respect to transport, deposition, resuspension, and filtration of fission product aerosols released in a reactor accident. Theoretically, electrostatic charging of the particles and of ungrounded surfaces, ionization of the gaseous environment, and surface effects, such as desorption of gases, can have a direct bearing on the properties of radioactive particles. Studies of the behavior of radioactive aerosols produced by exploding wires suggest that properties which depend on the presence of asymmetry in the distribution of electrostatic charge are modified by the enhanced conductivity of the air. Thus, in a low radiation environment, aerosols bearing a unipolar charge are deposited more rapidly in a container, because of space charge effects, than are radioactive aerosols of conductive particles which tend to lose an asymmetry of charge at a faster rate. In principle, nonconductive radioactive particles can accumulate a net unipolar charge which can increase their deposition rate; however, both high specific activity and extremely low conductivity are required to produce a significant effect. Concurrent studies on the adhesion of radioactive particles to other particles or to surfaces indicate that, depending upon conductivity and upon the radiation properties of the materials involved, the effect of unipolar charge is to decrease adhesion between radioactive nonconductor particles, but to increase deposition and adhesion on irradiated dielectric surfaces. Author (NSA)

N66-20548# California Univ., Berkeley. Lawrence Radiation Lab.
SPIN ANALYSIS FOR THE I=0 3 PION SYSTEM
G. Goldhaber 8 Jul. 1965 25 p refs Submitted for Publication
(Contract W-7405-ENG-48)
(UCID-2608; TG-128) CFSTI: HC $1.00/MF $0.50

The I=0 states of the 3-pion system having J^{PG} 0^{--}, 1^{--}, 1^{+-}, 2^{--}, and 2^{+-} are considered. For the simplest matrix elements for these states, a method denoted general symmetry analysis is used to find a graphical representation of the density distributions for the states. NSA

N66-20549# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
PURITY OF γ-RAY EXCITED X-RAY SOURCES
J. S. Watt Apr. 1965 9 p refs Submitted for Publication
(AAEC/TM-226, Suppl. I)

Gamma excited X-ray sources, yielding essentially monoenergetic X-rays of energy variable in the range from a few to 100 keV, were developed. Gamma rays from a radioisotope excite a target material and fluorescent X-rays with energies characteristic of the material are emitted. Only fluorescent X-rays and scattered γ rays can emerge from the source assembly since the direct γ rays are eliminated by shielding. The efficiency, purity (i.e., the ratio of the number of K X-rays to the number of scattered γ rays) and some practical aspects of this type of source are discussed. Since the fluorescent X-rays are of well-defined, discrete energies, γ excited X-ray sources should find a wide use in applications involving X-ray fluorescence. Author (NSA)

N66-20554# Brookhaven National Lab., Upton, N. Y.
MAGNETIC FINGERS
R. B. Palmer Mar. 1965 18 p refs Presented at the CERN Informal Neutrino Conf., Geneva, 20-22 Jan. 1965
(Contract AT(30-2)-GEN-16)
(BNL-9062; CONF-650111-2) CFSTI: HC $1.00/MF $0.50

A distribution assumed for positive pion momenta emitted at various angles in the interactions of 30 GeV protons with Be is presented; the positive kaon flux is assumed to be 1/10 of the pion flux. These distributions are used to calculate the neutrino spectrum, from the pion and kaon decay, expected using the CERN horn. The CERN horn is compared with an ideal focusing device, which focuses all particles toward the neutrino detector regardless of their angle, momentum, or point of origin. The ratio of the mean particle angles before and after a focusing device is examined as a function of particle momentum, for various focusing configurations. The shape calculated to focus the most popular momentum is illustrated and called a finger current sheet. The neutrino spectrum obtained using a triple combination of magnetic fingers is shown and compared with the ideal spectrum. NSA

N66-20557# Oak Ridge National Lab., Tenn.
S-WAVE NEUTRON STRENGTH FUNCTIONS OF ISOTOPES IN THE 3-s RESONANCE REGION FOR 40>A<70.
R. Wagner, W. M. Good, and D. Paya [1962] 5 p ref Presented at the Intern. Conf. on the Study of Nucl. Struct. with Neutrons, Antwerp
(Contract W-7405-ENG-26)
(ORNL-P-1371; CONF-650706-5) CFSTI: HC $1.00/MF $0.50

The even-even compound nuclides consisting of ^{44}Ca, ^{48}Ti, ^{50}Ti, ^{54}Cr, ^{58}Fe, and ^{62}Ni are studied in the mass region of the 3s strength function resonances. The Li(p,n) reaction and a relatively thick target are employed to measure transmissions by time-of-flight in the energy range 2-60 keV with an energy precision of better than 2%. Diagrams

give the total cross sections of the nuclides. The s-wave strength function and average level spacing are tabulated. Data are used to classify the nuclei in the region of the 3s giant resonance according as the compound nuclei are even-even, odd-odd, or even-odd. NSA

N66-20558*# Oak Ridge National Lab., Tenn.
NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL NUCLEON-MESON CASCADE EQUATIONS
R. G. Alsmiller, Jr., J. E. Murphy, and J. Barish [1964] 14 p refs Submitted for Publication
(NASA Order R-104; Contract W-7405-ENG-26)
(NASA-CR-71616; ORNL-P-299) CFSTI: HC $1.00/MF $0.50 CSCL 20H

In shielding calculations for high energy accelerators it is necessary to solve the nucleon–meson cascade equations numerically for very large distances. For the case of a 10 GeV proton beam and a set of quite special physical assumptions, an analytic solution is obtained and compared with the numerical solution. The two solutions are shown to be in excellent agreement for thicknesses as large as 30 collision mean free paths ($\sim 2800 g/cm^2$). Author (NSA)

N66-20579# Aeronutronic, Newport Beach, Calif.
CALCULATION OF INELASTIC ELECTRON-ATOM AND ELECTRON-MOLECULE COLLISION CROSS SECTIONS BY CLASSICAL METHODS
Ernest Bauer and Charlotte E. Bartky Jan. 1965 127 p refs
(U-2943; AD-627033) CFSTI: HC $4.00/MF $0.75

Use was made of Thomson's, Gryzinski's and Ochkur's classical methods for energy transfer in electronic collisions together with the quantum mechanical Franck-Condon factor for the overlap of nuclear wave functions to compute inelastic electron-molecule collision cross sections. Specific application is to ionization and to direct and exchange electronic excitation. After first extending previous applications of the classical energy transfer methods to atoms, we make calculations for a number of processes involving air molecules (N_2, N_2 (+), NO, O_2, also CO). The results are applied to the near-threshold domain as well as to the overall behavior of the cross section. Agreement with the very few absolute experimental data available is to within better than a factor of 2-3. This must be regarded as encouraging when one considers that there exist hardly any experimental data on excitation and that quantum mechanical calculations would be prohibitively lengthy to carry out while the present calculations are very simple to perform. Author (TAB)

N66-20589# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF GAMMA RADIATION ON THE FLUORESCENT YIELD OF RUBY
S. V. Starodubtsev and M. Yunusov 3 Dec. 1965 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), no. 1, 1965 p 111–112
(FTD-TT-65-1074/1+2+4; AD-625294) CFSTI: HC $1.00/MF $0.50

Centers of coloration formed on radiating ruby with gamma rays are shown to have no apparent contribution to its luminescence; nonradiating transitions predominate, the centers possibly extinguishing luminescence, reducing its yield. The appearance of such centers is regarded as being connected with the presence of impurities. The centers are found in the form of occlusions, and they create local defects in the crystals. Radiation of these defects causes localization of the defects or holes. TAB

N66-20593# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
ELECTRON-NUCLEUS MAGNETIC INTERACTIONS IN Cs METAL
D. F. Holcomb, J. A. Kaeck, and J. H. Strange Dec. 1965 17 p refs
(Contract Nonr-401(54))
(TR-1; AD-625687) CFSTI: HC $1.00/MF $0.50

The characteristic nuclear magnetic resonance parameters, Knight shift line shape and width, and relaxation times, were measured in cesium metal from the melting point to 1.4°K. The nuclear spin relaxation time, S, is inversely proportional to the temperature from 300°K to 7°C, with $T_1T = 0.13 \pm 0.01$ sec-°K. For temperatures below 7°K, the relaxation shows another contribution. The Knight shift increases linearly with temperature down to 4°K, following the line previously measured by Gutowsky and McGarvey at higher temperatures. Diffusion narrowing of the magnetic resonance line is observed at 190°K, but the strong electron-nuclear interactions preclude good diffusion constant measurements. Author (TAB)

N66-20651# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
MORE RESTRICTIVE COMMUTATION RELATIONS FOR QUARKS
Shigeo Hatsukade Dec. 1965 12 p refs
(RIFP-51) CFSTI: HC $1.00/MF $0.50

The quarks have two properties possessed by no other particles, i.e., they are fractionally charged and obey the parafermi statistics of order three. However, if the quarks behave like ordinary particles in other respects, the problem of why particles with fractional charges are not found experimentally arises. It is proposed that the coordinates and momenta of the individual quarks within a baryon do not commute with each other. This proposal by itself does not provide a complete solution to this question; however, it serves to reduce the number of possible resonant states of baryons. The commutation relation considerations within SU(6) symmetry imply that severe limitations are imposed on the observations that can be made on the quarks within a baryon. It is shown that the momenta and mass of individual quarks in a baryon cannot be measured simultaneously. An assumption that the quark mass is exactly one third of the baryon mass leads to the Dirac magnetic moment of a quark which is only 7% off the experimental value deduced by Greenberg. E.E.B.

N66-20658# Research Inst. of National Defence, Stockholm (Sweden).
AN ENERGY-WEIGHTED M1 SUM RULE
G. Arbman Mar. 1966 30 p refs
(A-4475-411) CFSTI: HC $2.00/MF $0.50

An energy weighted M1 transition sum rule for nuclei is constructed, using shell model jj-coupled wave functions. The sum is compared to the model-independent energy weighted E1 sum, and calculated for spherical nuclei in the region $58 \leq A \leq 210$. Author

N66-20676# Johns Hopkins Univ., Baltimore, Md. Carlyle Barton Lab.
ENERGY TRANSFER BETWEEN EXCITED STATES OF Ho^{3+} IN $LaCl_3$ Interim Technical Report No. 1
John F. Porter, Jr. Jan. 1966 143 p refs
(Contract DA-31-124-ARO(D)-103)
(AROD-4194-4; AD-627348) CFSTI: HC $4.00/MF $1.00

The transfer of energy between excited states of Ho^{3+} in $LaCl_3$ was studied at 4.2° K. It was established that the ion pair process is responsible for the relaxation of the E level to

the C level by exciting an adjacent ion from the ground state to the first excited state, Y. A similar process is responsible for the J to E relaxation but in this case the emission of a phonon is also required to conserve energy. The rise time for E fluorescence with J excitation was measured and found to be equal, within experimental error, to the J decay time. This indicates only that if there are special sites for the ion pair interaction, the transition rate for the process is comparable to the radiative rate. The temperature dependence of the decay of the $^3H_6$ to the $^3H_5$ in Pr^{3+} as observed previously using the quantum counter technique is explained on the basis of a pair interaction. Comparisons are made with other investigations and areas of agreement or disagreement discussed. TAB

N66-20688# Atomic Energy Establishment, Winfrith (England). General Reactor Physics Div.
SCATTER
J. Broome Nov. 1965 14 p refs
(AEEW-M-605) HMSO: 1s 9d

The programme SCATTER is a KDF9 programme in the Egtran dialect of Fortran to generate normalized angular distributions for elastically scattered neutrons from data input as the coefficients of a Legendre polynomial series, or from differential cross-section data. Also, differential cross section data may be analyzed to produce Legendre polynomial coefficients. Author

N66-20689# Atomic Energy Establishment, Winfrith (England). Reactor Group.
SLP: A SINGLE LEVEL BREIT-WIGNER CROSS-SECTION GENERATING PROGRAMME
G. Doherty Jun. 1965 17 p refs
(AEEW-M-606) HMSO: 2s 6d

Unbroadened cross-sections are calculated from a single level Breit–Wigner approximation which allows for resonance–potential interference but not resonance—resonance interference. Doppler broadening, and instrumental resolution broadening for thin samples, are optionally performed by successive numerical convolutions. An energy point selected and discard system enables the cross-section over a specified energy range to be represented to a required degree of accuracy using the minimum number of energy points. The capacity of the program varies with the energy range and type of resonance (narrow or broad). About fifty resonances may be sufficient to generate an energy grid of 4000 energy points, which is the maximum allowable energy vector. The program is written in KDF9 EGTRAN (a Fortran dialect); output is printed and may be copied on cards, and intermediate results are stored on magnetic disc. Author

N66-20701# Polish Academy of Sciences, Cracow.
TRANSVERSE SPIN POLARIZATION IN ODD-MASS DEFORMED NUCLEI [POPRYECZNA POLARYZACJA SPINOWA NIEPARYYSTYCH GDEFORMOWANYCH JADER ATOMOWYCH]
Zbigniew Bochnacki and Stanistaw Ogaza Oct. 1965 18 p refs
(Rept.-428/PL) CFSTI: HC $1.00/MF $0.50

The spin polarization effect on the value of the magnetic parameter b_o for the K=1/2 rotational bands and on M1 transitions between low-lying states of odd-mass deformed nuclei is considered. The results of numerical calculations for the ground state rotational band of the ^{169}Tm nucleus are presented. Author

N66-20856# Tokyo Univ. (Japan). Dept. of Physics.
SYMMETRY OF STRONG AND WEAK INTERACTIONS
S. Nakamura and S. Sato (Rikkyo Univ.) [1965] 44 p refs
CFSTI: HC $2.00/MF $0.50

A proposed model, in which hyper charge is considered as the third component of new spin operators, is examined. Particle patterns are classified, and the symmetry of the interactions are considered in terms of isotopic spin and hyper spin. The symmetry breaking strong interactions are discussed, and an explanation is given for the observed mass spectrum and semi-strong decay of particles. The symmetry of weak interactions and of strong interactions are also discussed for both nonleptonic and leptonic modes. N.E.N.

N66-20890# Freie Univ., Berlin (West Germany).
INTERACTION OF THREE HYDROGEN ATOMS Final Technical Report
R. G. Wrzesinsky 1 Feb. 1965 142 p refs
(Grant AF-EOAR-61-22)
(AFOSR-65-1684; AD-625500) CFSTI: HC $4.00/MF $1.00

By using the valence bond method, the two lowest energy terms and the corresponding eigenfunctions of the system of three hydrogen atoms are calculated. The intention is to give a general survey about the global structure of the energy surfaces using a simple calculating procedure, rather than to calculate the terms with great accuracy confined to a few simple constellations. The coupling coefficients are calculated for the nonadiabatic motion of the nuclei confining the nuclei forming an equilateral triangle to the neighborhood of the constellation. For an investigation of the nonadiabatic H_2-H scattering problem this constellation might be of particular interest because the energy surfaces are degenerated in the equilateral triangle giving a strong contribution to the coupling effect. TAB

N66-20895*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
GAROL: A COMPUTER PROGRAM FOR EVALUATING RESONANCE ABSORPTION INCLUDING RESONANCE OVERLAP
C. A. Stevens and C. V. Smith 24 Aug. 1965 143 p refs
(Contracts SNPC-27; AT(04-3)-167)
(NASA-CR-71162; GA-6637) CFSTI: HC $4.00/MF $1.00
CSCL 20H

A computer program, GAROL, has been written to study resonance absorption. The program is an improvement over other programs, presently in use, by virtue of its ability to handle overlap effects between resonances of a resonance absorber and of mixtures of resonance absorbers. In addition, a wide choice of geometry, energy mesh spacings, and cross section representation is available to the user. Author

N66-20906# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
DETERMINATION OF TRITIUM CONTENT IN SAMPLES (A REVIEW). PART II [IL DOSAGGIO DEL TRITIO (RASSEGNA). PARTE II]
F. Corti 24 Mar. 1965 56 p refs In ITALIAN; ENGLISH summary
(ISS-65/9) CFSTI: HC $3.00/MF $0.50

The different instruments, by which the β-rays of Tritium can be detected, are reviewed; the different counting devices are classified and compared according to the condition of the sample to be measured. For liquid tritiated samples, a method for measuring the efficiency is described, and this method is also suitable for measuring two different radioisotopes present in the sample. Author

N66-20915# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
THE OBSERVATION OF CERENKOV RING IMAGES WITH AN IMAGE INTENSIFIER SYSTEM OF HIGH GAIN
P. Iredale, G. W. Hinder, D. J. Ryden, and A. G. Parham Oct. 1965 26 p refs
(AERE-R-5071)

Details are given on an apparatus used to measure velocities by detecting ring images produced by 5.8 Gev protons. The design of the Cerenkov device is summarized, with emphasis placed on the image intensifier system. A schematic of the system is included, its operation is described, and experimental procedures and findings are discussed. Results indicate that, with a sufficiently sensitive system, Cerenkov rings produced from a gaseous radiator can be observed and used to make accurate measurements. At all radii the velocity precision, expressed as a standard deviation, was $\delta\beta/\beta \sim \pm 2\times10^{-4}$. Assuming a gaussian distribution, this is equivalent to a full width at half maximum of $\sim 6\times10^{-4}$. It is pointed out that the improvement provided by the image intensifiers occurs because a least squares fit can be used, and it is obtained despite the broadening of the image due to the peripheral image spots resulting from lens aberations.
M.G.J.

N66-20994*# University of Southern Calif., Los Angeles. Engineering Center.
IMPACT PRESSURE PROBE RESPONSE CHARACTERISTICS IN HIGH SPEED FLOWS, WITH TRANSITION KNUDSEN NUMBERS
J. B. Wainwright and K. W. Rogers 18 Feb. 1966 86 p refs (Contract NAS8-11046)
(NASA-CR-61119) CFSTI: HC $3.00/MF $0.75 CSCL 20I

Response characteristics of the impact probe in the transitional regime between free-molecule and continuum flows have been investigated both experimentally and theoretically. Experimental data is presented for Knudsen numbers, based on probe diameter, ranging between 0.05 and 10 and with nominal Mach numbers of 1, 3, 6 and 10. The configurations tested were chosen with the view toward separating internal and external probe geometric effects in the transitional regime. Measurements were made with the probes held at the free-stream total temperature and at 41% of total temperature. The theoretical investigations of probe response were based on a first collision modification of the free-molecule model. Both internal and external effects are calculated and good agreement is shown with the experiments. The free-molecule theory is also extended to the more complicated internal probe geometries which were employed in the experiments. Application of these investigations to flight measurements is outlined.
Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N66-19798# Institut für Plasmaphysik G.m.b.H., Garching (West Germany).
PLANE MAGNETOHYDROSTATIC EQUILIBRIA WITH INTERIOR FIELD [EBENE MAGNETOHYDROSTATISCHE GLEICHGEWICHTE MIT INNENFELD]
Rudolf Gorenflo and Arnulf Schlüter Aug. 1965 36 p refs In GERMAN; ENGLISH summary
(IPP-6/41) CFSTI: HC $2.00/MF $0.50

Two-dimensional analogs are discussed for toroidal plasma equilibrium configurations with purely meridional electric currents which flow perpendicular to a given plane. Consideration is given to case in which no current flows inside the plasma and the pressure remains constant, as well as when there is current flow within the plasma and the pressure is variable. Equilibrium is possible in either case as long as the extremum inside the plasma is a field line of the flux function of the field.
M.W.R.

N66-19900# RAND Corp., Santa Monica, Calif.
OBLIQUE WAVE PROPAGATION IN A COMPRESSIBLE GENERAL MAGNETOPLASMA
H. Unz Aug. 1965 26 p refs
(P-3188; AD-626674) CFSTI: HC $2.00/MF $0.50

The refractive index equation has been derived for arbitrarily directed oblique waves in compressible general magnetoplasma with arbitrarily directed magneto-static field. The q factor obeys a general sixth order algebraic equation. Booker's quartic equation and Seshadri's result are found as particular cases and other particular cases have been discussed. The general result is checked by using tensor analysis methods and transformation of coordinates.
Author (TAB)

N66-19941# United Kingdom Atomic Energy Authority, Culham (England).
THE EFFECT OF A FINITE TEMPERATURE ON THE ELECTRON CYCLOTRON RESONANCE INSTABILITY
J. G. Cordey Jun. 1965 20 p refs
(CLM-R-44) HMSO: 3s

The effect of Landau damping on the electron cyclotron resonance instability is investigated for a Burt-Harris type model of a confined plasma cylinder. The axis of the cylindrical shell of plasma lies along a uniform magnetic field. The plasma is assumed to consist of three groups of particles, a group of electrons which move in concentric Larmor orbits about the axis of the cylinder, another group of electrons with no component of velocity perpendicular to the magnetic field and a group of ions also with no component of velocity perpendicular to the magnetic field. A dispersion relation is then deduced, for electrostatic perturbations of this system. Analytical and numerical results are presented for the stability criteria and growth rates of the instability.
Author

N66-19974# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
HIGH VACUUM MEASUREMENT BY MEANS OF VIRTUAL CATHODE RELAXATION TIME
O. Lloyd Jul. 1965 31 p refs Submitted for Publication
(CLM-P80)

The theory of virtual cathode formation in electron beams is reviewed. Destruction of a virtual cathode by the accumulation of residual gas ions is shown to occur in a time which is inversely proportional to pressure. This forms the basis of a method of measuring low pressure which may have some advantages over conventional ionization gauges, especially in the presence of high magnetic fields. Experimental results are presented where this effect is used to measure pressures in the range 10^{-4} to 4×10^{-9} Torr.
Author

N66-19982# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIGHT SPARK IN A MAGNETIC FIELD

G. A. Askar'yan, M. S. Rabinovich et al 3 Jan. 1966 9 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 1, no. 1, 1965 p 9–15
(FTD-TT-65-1311/1+2+4; AD-626958) CFSTI: HC $1.00/MF $0.50

Results are described of an investigation of a spark in the presence of an outer magnetic field, which can be used in developing a plasma cluster of sparks by diamagnetic induction signals. TAB

N66-20006# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Plasma Physics Research Lab.
THE INITIATION OF A GLOW DISCHARGE
P. Bletzinger, H. E. Johnson, and A. Garscadden Oct. 1965 25 p refs
(ARL-65-201; AD-626933) CFSTI: HC $1.00/MF $0.50

The initiation of a mercury-argon discharge was studied with emphasis on the establishment of the positive column. A high voltage, constant current power supply was switched by an electronic circuit which permitted independent control of the pulse length and of the pulse repetition frequency. The effects of the initial breakdown in the gas mixture were examined in detail using time resolved spectrographic techniques. After an initial period of approximately 1 millisec, the regular discharge features, (which under the experimental conditions included moving striations) started to appear. Image converter records showed that their initiation, in the form of a backward wave, was from the cathode, thus supporting the theory of Pekarek. It is concluded that in the study of decaying plasmas the assumption of initial spatial homogeneity is not always valid, and the position and degree of inhomogeneity will usually be a strong function of the initial conditions. Author (TAB)

N66-20024# Texas Univ., Austin. Plasma Dynamics Research Lab.
INFRARED MASER INTERFEROMETRY FOR TIME AND SPACE RESOLUTION OF ELECTRON DENSITY IN HIGH TEMPERATURE PLASMAS Technical Report No. 1
Robert F. Gribble, J. P. Craig, and Arwin A. Dougal Wright-Patterson AFB, ARL, Jul. 1965 132 p refs
(Contract AF 33(657)-11073)
(ARL-65-135; AD-626939) CFSTI: HC $4.00/MF $1.00

A 3.39μ He-Ne maser excited infrared interferometer was utilized for the investigation of time and space resolved electron density in a high temperature, dense plasma formed in the theta-pinch geometry. Dispersion of the coherent infrared radiation by the plasma electrons within an external resonator pulls the frequency of the coupled maser resonator with a resultant change in intensity. The maximum measurable electron density time variation of 3×10^{16} cm^{-3} μs^{-1} is achieved with a fast In As infrared detector, the resonators were operated with low coupling and at a relatively low Q. New diagnostic information on the magnetic compression of a Deuterium plasma is presented. Author (TAB)

N66-20037# Pennsylvania State Univ., University Park. Dept. of Physics.
THRESHOLD FOR STIMULATED RAMAN SPECTRA
R. V. Wick, T. A. Wiggins, and D. H. Rank [1965] 8 p refs Sponsored by Nonr

The effects of power and path length on the threshold for stimulated Raman production in methane and hydrogen were studied. A Korad giant pulse laser with a 3/8 by 4 in. ruby rod was used. The spectra were observed using gas cells of length 6, 20, and 100 cm. in length. The gain per unit length in intensity for a stimulated Raman line is a function of gas density, incident light or power intensity per unit area, line width, and molecular parameters. The independence of gain with focal length was verified using a six cm cell with a five cm lens and a 100 cm cell with a 50 cm lens. In both cases, the second anti-Stokes line vanished for pressures less than 55 lbs/in^2. Using a 20 cm cell with a 25 cm lens the pressure threshold of the first anti-Stokes line in methane was observed to be 70 lbs/in^2; with a 50 cm lens and the same power, the threshold was 180 lbs/in^2. In hydrogen, using a 100 cm cell with a 50 cm lens, the anti-Stokes line was not present below 260 lbs/in^2 for a constant line width; using a 20 cm cell the green anti-Stokes line vanished at 215 lbs/in^2. D.T.

N66-20058*# AVCO-Everett Research Lab., Everett, Mass.
[PLASMA RADIATION SHIELDING] Final Report
Jan. 1966 43 p refs
(Contract NASw-1101)
(NASA-CR-70802) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Reported is a brief summary of work accomplished on the Plasma Radiation Shielding concept, together with an indication of current research directions. The basic mode of instability appropriate to the electron cloud as envisaged for the Plasma Radiation Shield was identified. Subject to various qualifications, it was shown both experimentally and theoretically that this mode can be controlled by an appropriate choice of physical and geometrical parameters. The basic method of electron injection was demonstrated (at low voltage, and in a simple geometry), and shown to be in agreement with preliminary analysis. Calculations showed that early estimates of the weight of Plasma Radiation Shield were reasonably accurate. At present, no further engineering calculations of this kind are justified, but the situation remains under review. Also included is an annotated bibliography of existing literature on Plasma Radiation Shielding and related topics. M.R.W.

N66-20088 Technical Univ. of Istanbul (Turkey).
MAGNETOHYDRODYNAMIC FLOW IN AN ANNULAR CHANNEL IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD [AYNI EKSENLI IKI SILINDIR ARASINDA MAGNETOHIDRODINAMIK AKIM]
M. Emin Erdogan *In its* Bull. of the Tech. Univ. of Istanbul 1965 p 37–43 refs (See N66-20086 10-34) CFSTI: HC $4.00/MF $0.75

The problem investigated is the laminar steady-state flow of an incompressible, viscous, electrically conducting fluid through an annular channel in the presence of a uniform transverse magnetic field. An exact solution is obtained; thus it is valid for all values of Hartmann number. The solution gives the solution of the magnetohydrodynamic pipe flow in the case where the inner cylinder radius vanishes. Furthermore, the classical non-conducting-result is obtained. Author

N66-20113# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
INVESTIGATION OF THE UNIVERSAL INSTABILITY IN A THERMAL PLASMA DEVICE (Q-MACHINE)
Herbert Lashinsky Sep. 1965 23 p refs Presented at 2d Intern. Conf. on Plasma Phys. and Controlled Nuclear Fusion Res. Culham, England, 6–10 Sep. 1965
(Grant AF-AFOSR-141-65)
(BN-415; AFOSR-65-2053; AD-627261 CFSTI: HC $1.00/MF $0.50

Results are described that were mental investigations of the so-called universal (drift-wave) instability in a weakly inhomogeneous fully ionized plasma column confined by a strong magnetic field. TAB

N66-20114# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATIONS OF THE ELECTRICAL AND OPTICAL PROPERTIES OF ARGON IN A STABILIZED ARC

A. Yu. Sheyndlin and E. I. Asinovskiy 21 Dec. 1965 12 p refs Transl. into ENGLISH from the Russian

(FTD-TT-65-1236/1+2; AD-627007) CFSTI: HC $1.00/MF $0.50

The paper reports on the experimental setup developed at the Scientific Research Institute for High Temperatures at the MEI for high-temperature investigations of electrical conductivity, viscosity, thermal conductivity, and emissivity of gases at up to 10,000–15,000°K; it takes the form of an electric arc stabilized by cooled copper walls. The use of such arc chambers in the practical work of physics laboratories offers several advantages, for example, over shock tubes. In particular, it is important to be able to obtain thermodynamic plasma states fairly close to equilibrium for a fairly large current in the high-pressure arc, together with comparative simplicity in setting and adjusting the thermodynamic parameters for the state of the gas in the discharge. TAB

N66-20209# Stanford Univ., Calif. Inst. for Plasma Research.

WAVE PROPAGATION ALONG A WARM NONUNIFORM PLASMA COLUMN

F. W. Crawford and J. A. Tataronis May 1965 30 p refs

(Contract AT(04-3)-326)

(SU-IPR-11) CFSTI: HC $2.00/MF $0.50

The dipolar resonances that occur when an axially uniform plasma column is subjected to a transverse rf electric field have received much study, and can be predicted accurately from a hydrodynamic description of the plasma perturbation and knowledge of the transverse electron density profile. These frequencies may be interpreted as the cutoffs of series of modes propagating along the column. Such propagation is studied in infinite planar geometry for a number of basic cases. Dispersion curves and descriptions of the plasma parameters at cutoff are given for modes with axially symmetric and axially asymmetric potential distributions in three different geometries: first for plasma filling the plates, and then for plasma separated from the plates either by one or two dielectric layers. The feasibility of observing these waves experimentally is discussed, and experimental evidence for their propagation is cited. Author (NSA)

N66-20233# California Univ., Livermore. Lawrence Radiation Lab.

DISPERSION RELATION FOR RELATIVISTIC STREAMS OF FINITE RADIUS

Ronald W. Landau 4 Jan. 1965 82 p

(Contract W-7405-ENG-48)

(UCRL-12207) CFSTI: HC $3.00/MF $0.75

The problem of instability and radiation emission from longitudinal plasma oscillations was examined. Assuming pure longitudinal motion, a dispersion relation for relativistic streams with finite radius was derived. The dispersion relation contains distinctly new terms and indicates that the two-stream instability can drive the plasma radiation. NSA

N66-20258# California Univ., Livermore. Lawrence Radiation Lab.

INVESTIGATION OF A PLASMA FROM AN OCCLUDED GAS, COLD PLASMA SOURCE

James F. Steinhaus, Norman L. Oleson (Naval Postgraduate School), and William L. Barr 13 Jan. 1964 57 p refs

(Contract W-7405-ENG-48)

(UCRL-7935) CFSTI: HC $3.00/MF $0.75

Plasma was generated in a source using a hydrogen-loaded titanium washer with power supplied by a variable-length square wave pulse line (15-635 μsec). The source was mounted on the axis at one of two coils forming a magnetic mirror geometry. Spectroscopic studies were made to: identify the types of ions present (H, Ti^+, Ti^{++}, Ti^{+++}, O^+, O^{++}, Al, Al^+, Al^{++}, Ta^+), measure ion velocities by Doppler shift (from 5×10^5 to 2×10^6 cm/sec), and record the variation of light intensity with time. Microwave cutoff measurements made simultaneously with various frequencies provided time history curves of the plasma densities, which exceeded 1 to 3×10^{14} electrons per cm^3. Parameters affected by the age of the hydrogen-loaded washer were examined. Studies of the electron density decay after the end of the pulse revealed that the decay time is determined by the rate of cross field diffusion and is intermediate between the rates calculated simply for ion diffusion and those calculated for ambipolar diffusion. Microwave interferometer fringe shift measurements provided information on the plasma charge density profile. Profile measurements were also made using a thermistor located close to the gun to measure the relative energy contributions of the intercepted neutral and charged particles. This allowed an evaluation of the percentage of neutrals present in the plasma column ($\approx$10%). The floating double probe technique was used to measure electron temperatures and time of flight. Electron temperatures were found to decrease with time during the pulse the variation being from 15 to 1 eV and 3 to $<$1 eV for old and new source washers, respectively. Results of these various investigations are presented together with a discussion of the probable mechanisms involved. Author (NSA)

N66-20278# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.

PROPERTIES OF ALKALI-METAL MAGNETOPLASMAS RELATED TO ENHANCED DIFFUSION

N. Wolf and K. C. Rogers [1964] 9 p refs Presented at the Intern. Symp. on Diffusion of Plasma Across a Magnetic Field, Fedlafing/Starnberger See, West Germany, 29 Jun.–3 Jul. 1964

(Contract AT(30-1)-2813)

(NYO-2813-30; CONF-640621-1) CFSTI: HC $1.00/MF $0.50

Studies on thermal cesium and potassium plasmas in a magnetic field gave evidence for the presence of unexpected high particle losses in these plasmas. The observed losses may be related to those reported earlier by Bonnal et al. in a PIG discharge, where no directed axial current was present either. The results suggest that the anomalies are associated with transverse electron currents near the ends of the plasma column. Author (NSA)

N66-20375# Texas Univ., Austin. Plasma Physics Lab.

DAMPING AT THE LOWER HYBRID RESONANCE IN A WARM PARTIALLY IONIZED PLASMA

M. E. Oakes and H. Schlueter Feb. 1965 23 p refs

(Contract AT(40-1)-3110)

(TID-21943) CFSTI: HC $1.00/MF $0.50

It is shown from a three-fluid analysis including electron pressure that the strong neutral component present in a previous experimental study of the hybrid ion-electron resonance simply increases the damping and, for the range of parameters involved, suppresses the effects of pressure terms on the resonance features. Author (NSA)

N66-20401# California Univ., Livermore. Lawrence Radiation Lab.

HIGH-PRESSURE SHOCK WAVE EXPERIMENTS IN ARGON AND XENON

R. Norris Keeler, Berni J. Alder, and Mathias van Thiel 17 May 1965 19 p refs Presented at the 5th Shock Tube Symp., Silver Spring, Md.
(Contract W-7405-ENG-48)
(UCRL-12366; CONF-650435-1) CFSTI: HC $1.00/MF $0.50

The following were shown from work in expendable shock tubes: pairwise additivity for argon and xenon holds at close interatomic separations; the repulsive potential for argon and xenon is a universal function; and accurate intermolecular potential for argon and xenon was derived; deviations from classical behavior due to electronic effects are significant at the highest pressures for xenon; and the melting transition in argon was observed Author (NSA)

N66-20429# Los Alamos Scientific Lab., N. Mex.
EFFECT OF INNER FIELD FLUCTUATIONS ON PLASMA IMPEDANCE
O. Theimer 1964 25 p refs Preprint
(Contract W-7405-ENG-36)
(LA-DC-6603) CFSTI: HC $1.00/MF $0.50

The effective field acting on the electrons in a plasma is studied by methods similar to those employed for analyzing the dielectric properties of neutral gases. The difference between incident and effective field is the polarization field which is associated with the displacement of ions relative to electrons. This latter field is found to be a sensitive function ion density. The plasma impedance is averaged over these fluctuations and is shown to satisfy a formula of the form $Z=Z_1[1+\Sigma_{\nu=1}^{\infty}C_\nu(n_0\alpha_0)^\nu]^{-1}$ where n_0 is the average electron density, $\alpha_0=-\omega_p/4\pi\omega^2 n_0$ is the free electron polarizability, ω_p is the electron plasma frequency, and ω is the frequency of the driving field. The coefficients C_ν (which are zero if field fluctuations are neglected) have the magnitude $C_1=0$, $C_2=0.8[1-7.6(\omega/v_0 n_0^{1/3})^2-i\ 11.2(\omega/v_0 n_0^{1/3})^3]$, where v_0 is the average thermal electron velocity. The frequency dependence of Z is quite different from that of the uncorrected impedance Z_1. Author (NSA)

N66-20490# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
DISTRIBUTION OF THE RELATIVE CONCENTRATION OF ATOMS AND IONS ALONG AND ACROSS THE GAS DISCHARGE IN A HEAVY ION SOURCE [RASPREDELENE OTNOSITEL'NOI KONTSENTRATSII ATOMOV I IONOV PO SECHENIYU GAZONOGO RAZRYADA I VDOL NEGO V ISTOCHNIKE MNOGOZARYADNYKH IONOV]
L. P. Kul'kina and A. S. Pasyuk 1965 19 p refs In RUSSIAN
(JINR-P-2043)

The distribution of the concentrations of Ne, Ar, and Kr atoms and ions were investigated in the plasma column of an arc ion source with oscillating discharge. The optical method was used. The atom and ion distribution along the arc column has a peak near the center of the gas discharge chamber of the source. The effect of the electrode material on the atom and ion distributions along the arc column is established. The Ne ion concentration distribution across the chamber has a peak on the axis of the gas discharge filament. Author (NSA)

N66-20532# California Univ., Livermore. Lawrence Radiation Lab.
THE MEANING AND THE USE OF PHOTOMETRIC TERMS
George A. Condas 20 May 1964 50 p refs Preprint
(Contract W-7405-ENG-48)
(UCRL-7816) CFSTI: HC $2.00/MF $0.50

A simple, comprehensive, and objective discussion of photometry and photometric terms is given. All of the common photometric units and also some of the rarer ones are discussed. Arguments are given for abolishing certain photometric terms on the basis of eliminating confusion. Many of the discrepancies found in the literature, past and modern, are discussed and rectified. A simple and sufficiently accurate mathematical expression is also proposed for the relative luminous efficiency of radiation. Numerous tables, equations, and applications, all as up to date as possible, are presented to enable the reader to use and understand photometry, its units, and its applications. Author (NSA)

N66-20556# California Univ., Berkeley. Inst. of Engineering Research.
THERMAL STRESSES DURING RAPID TRANSIENT HEATING. PART I: HEATING CHARACTERISTICS OF A PLASMA GENERATOR Final Report
J. Frisch and W. H. Giedt Feb. 1965 68 p refs
(Contract W-7405-ENG-48)
(UCRL-13147, Pt. 1) CFSTI: HC $3.00/MF $0.75

The performance characteristics of a dc arc plasma generator were experimentally investigated. Relationships between the necessary defining parameters were established. Independent parameters considered were voltage, power input, nitrogen gas flow rate, nozzle diameter, and electrode geometry. To determine the properties of the plasma stream, a method based on the energy balances made with a calorimeter was developed. The performance of the plasma generator was further investigated by applying theoretical background gained from a study of the nature of the electric arc. This investigation was necessary for a greater comprehension of the phenomena involved in the operation of the plasma generator. Within its operating range, the plasma generator was found to perform reliably. This operating range permits the use of from 40 to 92 kilowatts of electrical power. The ranges of currents and voltages were 340 to 670 amperes and 109 to 190 volts, respectively. Operating at overall efficiencies of from 25% to 75%, the plasma generator delivered an enthalpy rate of from 11.4 to 55.8 kilowatts to the plasma stream. The resulting plasma gas enthalpies ranged from 1370 to 3300 Btu/lb with the corresponding temperatures ranging from 4340 to 9020°F. Author (NSA)

N66-20563# Cammisseriat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
PLASMA DIODES [LES DIODES A PLASMA]
Jean-Claude Gondrand (Ph.D. Thesis) Apr. 1965 19 p refs
(CEA-BIB-55)

Presented are the possibilities offered by plasma diodes. In the first part, a study is made of the theoretical efficiency of such a convertor without taking into account the losses, apart from the electronic cooling. The exact expression for this efficiency is then calculated by adding the losses due to the power radiated in the direction of the anode, to the fall in the ohmic voltage and to the thermal conduction of the cathode conductor. By optimization, the value of the efficiency for a given temperature is provided by a transcendental equation. It is shown in part two how the physical problems have been resolved: elimination of the space charge, choice of materials for the anode and cathode, use of a moderate temperature chain fitted with thermo elements. Author (NSA)

N66-20590# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF ELECTRON TEMPERATURE IN A CESIUM LOW-VOLTAGE ARC

Yu. K. Gus'kov and A. I. Kiryushchenko 20 Dec. 1965 9 p refs Transl. into ENGLISH from Russian
(FTD-TT-65-1969/1+2+4; AD-625807) CFSTI: HC $1.00/MF $0.50

Results are presented of the measurement of the electron temperature in a low-voltage arc in vapors of cesium with an admixture of zinc, in accordance with the recombination continuum. TAB

N66-20600# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF THE MECHANISMS ASSOCIATED WITH GAS BREAKDOWN UNDER INTENSE OPTICAL ILLUMINATION Semiannual Report, Aug. 1–Dec. 31, 1965
Alan F. Haught and David C. Smith Jan. 1966 24 p refs
(Contract Nonr-4696(00); ARPA Order 306; Proj. Defender)
(UACRL-E920272-6; AD-627233) CFSTI: HC $1.00/MF $0.50

An experimental and theoretical study of the physical processes leading to the ionization of gases by intense optical radiation was conducted. The high-intensity beam from a Q-spoiled ruby or neodymium laser is focused by a lens and used to cause electrical breakdown in a test gas. The production of ionization is examined as a function of the laser beam intensity, gas type, pressure, volume within which the breakdown occurs, and frequency of the radiation. Studies have been made of the breakdown threshold of mixtures of the inert gases to determine the effects of controlled impurity levels on the breakdown process. In these experiments it was found that at 5×10^4 mm Hg the breakdown threshold of a 1 per cent neon, 99 per cent argon gas mixture was lower than that for pure argon, even though at any given pressure the breakdown threshold of neon along is greater than that for argon. Measurements of the pressure dependence of the breakdown threshold of the gas mixture show the importance of gas collisions in the development of breakdown at high pressures and suggest that radiation energy transport may be the diffusion-like loss reported earlier. To examine further the growth of the breakdown region, studies have been made of the expansion of the breakdown plasma using a high-speed image. Author

N66-20631# Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
THE VARIATION OF THE ADIABATIC INVARIANT OF THE HARMONIC OSCILLATOR
G. Knorr and D. Pfirsch Oct. 1965 20 p refs
(MPI-PAE/Pl.15/65) CFSTI: HC $1.00/MF $0.50

A solution is offered to the problem of computing the actual change of the magnetic moment for the case of a spiraling particle in a homogeneous, time varying magnetic field. The solution is given as an absolutely converging series, and some asymptotic results are discussed. M.G.J.

N66-20724# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE NEUTRALIZATION OF SPHERICALLY DIVERGENT FLUXES OF CHARGED PARTICLES
V. A. Levin 11 Jan. 1966 10 p refs Transl. into ENGLISH from Zh. Mekhan. i Tekhn. Fiz. (Moscow), no. 3, 1965 p 68–70
(FTD-TT-65-1812/1+2+4; AD-626972) CFSTI: HC $1.00/MF $0.50

The process is examined of neutralization of a spherically divergent flux of ions. It is shown that depending upon the magnitudes of the determining parameters two different behaviors of the potential in the neutralized flux are possible. In contrast to the planar case, when undamped oscillations of potential occur in the spherical case the potential either achieves damped oscillations or monotonically goes to the limiting value. The results of numerical calculation for neutralization of a flux of cesium ions by electrons are introduced as an example. TAB

N66-20821# RAND Corp., Santa Monica, Calif.
LORENTZ INVARIANCE, MOMENTUM-ENERGY TENSORS, AND THE M H D PROBLEM
Dominic G. B. Edelen Nov. 1965 46 p refs
(Contract AF 49(638)-66-C-0001; Proj. RAND)
(RM-4763-PR; AD-625268) CFSTI: HC $2.00/MF $0.50

There has long been controversy as to the 'correct' form of the momentum-energy tensor and of the force law and/or the current vector in general formulations of magnetohydrodynamical problems. This memorandum attempts to clarify the various questions involved and presents two alternative methods of procedure whereby internally consistent, physically well-set formulations can be obtained. The major emphasis on the Hamiltonian approach in terms of Lorentz invariance. The results should be of use in both theoretical and applied problems. TAB

N66-20921# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
STUDY OF GAS DISCHARGES THAT ARE EXPECTED IN A CLOSED CYCLE MAGNETO-HYDRODYNAMIC GENERATOR
M. Sakuntala Dec. 1965 78 p refs
(AERE-R-5107) HMSO: 10s

In a feasibility study of closed cycle magnetohydrodynamic generators, experiments were conducted in which the gas temperature and the partial vapor pressure of the seed are taken to be the prime variables of the gas phase studied. The experimental apparatus and measurement methods are described, and detailed data are given on the production and motion of charges in the gas mixture, the low and high current regimes, transition neutralization, and the experimental verification of space charge neutralization and electron temperatures. Among the conclusions drawn from an interpretation of the experiments were: (1) The low currents are thermionic emission currents from the cathode surface, released as a result of the partial neutralization of the space charge by the positive ions. (2) The enhancement in electron energy is due to the applied potential between the electrodes plus the gas temperature. (3) The rare gas acts as an elastic scatterer of electrons and ions but is not ionized or excited. (4) The plasma electron temperature measurements by double probe method shows a definite increase in energy over the gas temperature. M.G.J.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-19905# General Dynamics/Electronics, Rochester, N. Y.
RESEARCH ON A FERROACOUSTIC INFORMATION STORAGE SYSTEM Final Report, 10 Jun.–10 Dec. 1964
J. W. Gratian and R. W. Freytag Jan. 1965 47 p refs
(Contract NASw-592)
(NASA-CR-71031) CFSTI: HC $2.00/MF $0.50 CSCL 20L

The ferroacoustic memory technique provides nonvolatile, updatable information storage, serial access to data without use of mechanical moving parts, and non-destructive data readout. The storage medium is a strain-sensitive ferromagnetic delay line. Write-in at any specified address is accomplished by the coincidence of a traveling sonic pulse and a properly timed magnetizing current pulse applied along the axis of the entire line. Evaluation of single-line models operated at a data rate of 330 kc show practicable S/N over a temperature range of −20°C to +85°C. Performance and physical characteristics for multiple-line memories are estimated. Investigation of advanced approaches for improving speed and data densities includes exploration of ultra-thin, mill-processed media and thin films. Improved procedures for the measurement and interpretation of strain-sensitive material characteristics, and progress in the study of both isotropic and anisotropic thin films, are discussed. Author

N66-19917# Research Triangle Inst., Durham, N. C.
INTEGRATED SILICON DEVICE TECHNOLOGY. VOLUME X: CHEMICAL/METALLURGICAL PROPERTIES OF SILICON
B. N. Padnos Nov. 1965 190 p refs
(Contract AF 33(615)-1998)
(ASD-TDR-63-316; Vol. X; AD-626985) CFSTI: HC $5.00/MF $1.00

A complete set of existing silicon binary phase diagrams and a complete listing of known binary silicides, along with some of their properties, are presented in convenient reference form. Reactions of silicon with common reagents are summarized, emphasizing those reactions dominant in the chemical etching and polishing of silicon. A technique for spin-etching silicon wafers is also described. Author (TAB)

N66-19973# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, VOLUME 1965, NUMBER 4, OCTOBER, NOVEMBER, DECEMBER 1965
J. J. Diamond, ed. et al [1966] 66 p refs Prepared jointly with NBS
Available from Natl. Bur. Std., Washington, D. C.

This bibliography lists 75 publications in the fields of high temperature chemistry and physics of condensed materials. Primarily considered were devices for achieving temperatures above 1500°C, and properties of materials which melt around 1000°C. G.G.

N66-19984# Microwave Associates, Inc., Burlington, Mass.
RESEARCH ON MILLIMETER-WAVE GENERATION TECHNIQUES Technical Report, 1 Apr. 1964–1 May 1965
T. B. Ramachandran, M. Gilden, and J. Pergola Dec. 1965 124 p refs
(Contract AF 33(657)-10925)
(AFAL-TR-65-290; AD-626195) CFSTI: HC $4.00/MF $0.75

Research was performed on two programs; Task I, millimeter-wave generation using the electro-optical approach; Task II, microwave generation using bulk properties of gallium arsenide by direct conversion from d-c or pulsed sources. Using a PIN structure of the GaAs (x)P (1-x)–GaAs material system, a photodetector has been fabricated that is capable of detecting beat frequencies from a gallium arsenide laser of at least 40 Gc. This heterojunction structure has an 11% phosphide P+ layer for the light incident surface and is compatible with gallium arsenide light sources. Also presented is the investigation into the inefficiency of the 80% phosphide heterojunction structure. The generation of microwave energy (Task II) using bulk properties of gallium arsenide (currently called the 'Gunn effect') is discussed in terms of both large- and-small-signal theory. The large-signal theory involves the concept of moving domains resulting from an electric field controlled negative resistivity. The small-signal theory involves spacecharge wave propagation which results in negative resistance effects at the sample terminals. Qualitatively, the effect of carrier transit-time, terminal condition and doping level are given. Author (TAB)

N66-20014# Mallory (P. R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science.
INVESTIGATION OF ULTRA HIGH VACUUM SPUTTERED THIN FILMS Final Report, 1 Nov. 1963–31 Oct. 1965
George Wallis, Sumner P. Wolsky, and Ernest E. Pittelli 30 Nov. 1965 47 p refs
(Contract AF 19(628)-3840)
(AFCRL-65-891; AD-626443) CFSTI: HC $2.00/MF $0.50

The structural and electrical characteristics of low pressure sputtered germanium films deposited on amorphous and single crystal substrates were investigated. The very low deposition rates of the experiments provided an opportunity to examine film growth as a function of the important parameters which influence it. The results of the investigation on amorphous quartz substrates have been presented in the paper entitled 'Low Pressure Sputtered Germanium Films'—J. Vac. Sci. and Tech. 2, 97 (1965). The most recent work concerned with insulating single crystal substrates is presented in the report. Preliminary investigations were made of the structural and electrical characteristics of silicon films sputtered under similar conditions as those used for germanium. The major factor of interest uncovered in this limited investigation concerned the apparently greater mobility of the deposited silicon atom on self substrates as compared to sapphire substrates. Author (TAB)

N66-20018# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
PROPERTIES OF PIEZOELECTRIC MATERIALS
Bruce D. Wedlock Jun. 1964 82 p refs
(AMRA-MS-65-05; AD-611212) CFSTI: HC $3.00/MF $0.75

The purpose of this monograph is to provide a source of data on a wide variety of piezoelectric materials which will be useful to those conducting research in this area as well as to the engineer designing ultrasonic transducers, filters, and other piezoelectric devices. The numerical data are given in the rationalized MKS system in accordance with the IRE Standards on Piezoelectricity, as are the symbols employed. Table I defines the symbols employed and gives their MKS unit. Since a large amount of literature still uses the CGS system, Table II presents the factors to convert CGS units to MKS units. On the data pages, the digits in the data columns are to be multiplied by the power of ten in the column immediately to the right of the symbol to obtain the value in the MKS system. The compounds are arranged alphabetically by chemical name. The pure compounds are followed by the binary alloys, followed by ternary compounds, etc. The multiple component compounds are arranged alphabetically by main constituent, secondary constituent, etc., and by decreasing amount of main constituent. Author (TAB)

N66-20028# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE CORRELATION BETWEEN THE CRITICAL SHEAR STRESS OF NEUTRON IRRADIATED COPPER CRYSTALS AND THE DENSITY OF DEFECT CLUSTERS

M. J. Makin, F. J. Minter, and S. A. Manthorpe Aug. 1965 18 p refs
(AERE-R-5032)

An attempt was made to determine experimentally the relationship between the density of defect clusters and the critical shear stress of single crystals during the annealing of neutron irradiated copper. Single crystal and foil specimens of the same purity, 99.999%, were irradiated together for the same dose, 2.5×10^{18} f.n.cm^{-2}, and examined after annealing for various times at 275°, 306° and 336°C. It was found that a single linear relationship existed between the critical shear stress at 4.2°K and the square root of the density of clusters less than 50 Å in diameter after anneals at all of the three temperatures. For the larger clusters linear relationships were not obtained and the results for the three annealing temperatures did not coincide. This work shows that irradiation hardening is almost entirely due to the small vacancy clusters and that the average value of the resistance F_{max} of each cluster is not less than 1.25×10^{-4} dynes. It is also concluded that although clusters of different size are present they all have approximately the same F_{max}. Author

N66-20038*# AVCO-Everett Research Lab., Everett, Mass.
CRITICAL CURRENT DEGRADATION IN WIDE SAMPLES OF HIGH FIELD STRIP SUPERCONDUCTORS
Ethan D. Hoag Jun. 1965 13 p refs
(Contract NAS8-5279)
(NASA-CR-70861; AMP-163) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Measurements of the magnetic anisotropy of critical current in samples wide enough for use in large magnets reveal a degradation effect in strip superconductors. The effect is manifested as a truncation of the peaks of the anisotropy curves of these samples. With narrow samples the anisotropy curves, i.e., average critical current density plotted as a function of magnetic field direction, normally display a well-defined peak centered about the direction parallel to the rolling plane of the strip. With wide samples, however, this peak appears progressively more truncated as the width is increased, and the truncation level, i.e., maximum current density, is roughly inversely proportional to the width, so that the total current tends to remain constant, independent of width. For Nb-25% Zr strip 0.051 mm thick, this limiting current is approximately 125 Å at a field of 4 Wb/m^2 for widths between 1 and 10 mm. Samples 1.32 mm wide display little or no truncation and have maximum current densities of 1.8×10^5 Å/cm^2, whereas 10 mm wide samples show severe truncation and have maximum current densities of 2.6×10^4 Å/cm^2. Author

N66-20039# Aktiebolaget Atomenergi, Stockholm (Sweden).
RADIATION INDUCED REMOVAL OF STACKING FAULTS IN QUENCHED ALUMINIUM
Ulf Bergewlid Dec. 1965 16 p refs
(AE-206) CFSTI: HC $1.00/MF $0.50

The effect of neutron irradiation on specimens of quenched aluminium containing Frank sessile dislocation loops has been studied by means of electron microscopy. The Frank loops were found to transform into perfect loops at doses less than 10_{17} nvt. A possible reason for the removal of the stacking faults is the displacement of a number of atoms at the faults, leading to the passage of a Shockley partial. Unfaulting induced by stress fields from dislocations, released during the irradiation, can also be important. Author

N66-20052*# Stanford Univ., Calif. Solid-State Electronics Lab.
FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE Quarterly Progress Report, 1 Jan.–31 Mar. 1965
[1965] 17 p refs
(Grant NsG-555)
(NASA-CR-70785) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Evaluated are the optical, electrical, and metallurgical properties of the $GaAs_xP_{1-x}$ alloy. Among evaluations of particular interest are the investigation of the crystal structure and its imperfections by the Kossel line technique and by that of the lattice absorption spectra as the mole fraction of GaAs, x, varies from 0 to 1. Alloy regions containing less than 30 percent P were studied and a method was developed to obtain controllable low feed rates of PCl_3 vapor necessary in the process of growing crystals in this region. Spectra of two phonon combination bands were also taken; the GaP-like band was traced down to the 5 percent P alloy. Two reflectivity maxima in the region of 25μ to 40μ were detected; they are located near the Reststrahlen bands of pure GaP and GaAs respectively. This does not agree with a previous assumption, made without benefit of spectra from alloys in this region, that the Reststrahlen band shifts continuously from GaP to GaAs. M.R.W.

N66-20053*# IIT Research Inst., Chicago, Ill.
STABLE WHITE COATINGS Summary Technical Report, 3 Jul. 1964–1 Dec. 1965
J. E. Gilligan 7 Feb. 1966 69 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950746)
(NASA-CR-70780; IITRI-U6004-21) CFSTI: HC $3.00/MF $0.75 CSCL 20L

This report presents the results of a program to study the induced optical properties and the photoreactions of zinc oxide. An analysis of the findings of an extensive literature search formed the basis of the experimental plan adopted in this program. Luminescence studies, chemical analyses, X-ray diffraction studies, reflectance measurements, and numerous mechanical and thermal treatments were carried out. For the most part the results compare well with the more commonly accepted results reported in the literature. It was conclusively established that ultraviolet-induced absorption in the infrared spectrum can be completely extinguished in a matter of seconds simply by increasing the environmental pressure to atmospheric. This finding will drastically alter many current concepts of space materials testing. The infrared bleaching effect in zinc oxide, whether it is limited to zinc oxide or not, will discourage automatic acceptance of routine pre- and post-test utraviolet irradiation data at least until competent testing establishes which materials need in situ testing and which do not. Author

N66-20067*# Naval Ordnance Test Station, China Lake, Calif.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE PHYSICS OF CRYSTALLINE SURFACES Annual Report, Feb. 1, 1965–Jan. 30, 1966
E. Bauer 31 Jan. 1966 28 p refs
(NASA Order R-05-030-001)
(NASA-CR-71022) CFSTI: HC $2.00/MF $0.50 CSCL 20B

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N66-20068* Naval Ordnance Test Station, China Lake, Calif. Michelson Lab.

THE GROWTH OF SINGLE CRYSTAL FILMS FREE OF IMPURITIES

A. K. Green, K. M. Kunz, and E. Bauer *In its* Theoret. and Exptl. Invest. of the Phys. of Crystalline Surfaces 31 Jan. 1966 7 p refs (See N66-20067 10-26) CFSTI: HC $2.00/MF $0.50

The growths of single crystal films from gold on NaCl and KCl through ultrahigh vacuum evaporation were studied by grazing incidence electron diffraction. In situ ultrahigh vacuum reflection electron diffractions showed that beginning with a partially coherent single crystal film of Au, a superstructure developed that was associated with an impurity-gold compound. This pattern was also observed by lower energy electron diffraction and has been attributed to an alkali-gold compound. It was concluded that the growth of single crystal films on alkali halides depends upon the residual gas pressure and composition, the history of the surface and the impurity content in the substrate, and on the interface reactions between the film and the substrate. G.G.

N66-20164# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECTS OF GAMMA AND X-RAYS ON THE ELECTRICAL PROPERTIES OF CADMIUM-SELENIUM AND CADMIUM SULFUR SEMICONDUCTORS

M. A. Talibi 20 Dec. 1965 16 p refs Transl. into ENGLISH from Tr. Inst. Fiz. i Mat., Ser. Fiz., Akad. Nauk Azerb. SSR (Baku), 1958, v. 9 p 10-19
(FTD-TT-64-1161/1+2+3+4; AD-627073) CFSTI: HC $1.00/MF $0.50

Effects on the electrical properties of sulfur-cadmium and sulfur-selenium semiconductors resulting from the photoelectric attenuation of incident gamma and X-ray radiation were investigated. Attenuation processes which include the photoelectric effect, Compton scattering, and pair production are discussed. The results of the effects of gamma rays and X-rays on the conductivity of polycrystalline selenium-cadmium specimens are given in graph form. It is concluded that for either high or low energy radiation quanta, phenomena depending on ionization in matter do not depend on the character of the ionization process but on the behavior of the charges liberated because of the ionization. The exponential law of attenuation was confirmed for the measured photoresistances. Saturation effects and inertial equilibrium effects in sulfur-cadmium specimens are mentioned. Preparation of p-n junction selenium rectifiers is described, and gamma and X-ray interactions are discussed. E.A.O.

N66-20186# ITT Industrial Labs., Fort Wayne, Ind.

IMPROVED QUANTUM EFFICIENCY LASER DETECTORS
Interim Engineering Report

K. R. Crowe and J. L. Gumnick 20 Jan. 1966 33 p ref (Contract AF 33(615)-3082)
(ITTIL-66-1002; AD-627046) CFSTI: HC $2.00/MF $0.50

This report covers the theoretical and experimental work completed during the first 4 months of the contract. An equation was derived relating photoelectric response to the optical and solid-state properties of photoemitters. The analysis includes the influence of multiple reflections of light from the photocathode boundaries and shows interference enhanced photoresponse for certain values of wavelength of the incident radiation and photocathode thickness. Photoelectric response for light entering the photocathode from the vacuum interface is compared to the response for light entering the photocathode from the glass interface for S-1 and S-20 photocathodes. The yield is generally found to be higher for light entering the photocathode from the glass substrate. It is believed that the relative yeilds of the two cases is partially determined by multiple reflections within the photocathode. The measurements of photoelectric yield versus photocathode thickness and experimental problems relating to the measurements are discussed. Experiments to be conducted during the remaining month of the contract are outlined. Author (TAB)

N66-20188# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

AN INVESTIGATION OF ATOMIC COLLISION SEQUENCES AND THERMAL SPIKES IN ALPHA-URANIUM

R. S. Nelson Oct. 1965 28 p refs
(AERE-R-5059)

Irradiation damage in α-uranium has been investigated during irradiation with 80 keV Kr+ ions. Ejection from the single crystals was found to occur preferentially near to the [100], [110] and [487] type directions. This is interpreted in terms of focused collision sequences travelling along these directions which, on intersecting the surface, cause ejection in the same direction. The possible focusing mechanisms are discussed for each sequence, and an estimate made of their focusing energies. Atomic ejection from the polycrystals was measured as a function of temperature. The sputtering ratio remained effectively constant from room temperature up to about 400°C, however between 400°C and 600°C an approximately exponential increase was observed. The increase is explained in terms of evaporation from thermal spikes created by the individual bombarding ions, and analysis of the results has provided information as to the spike's size, life-time and temperature. The spatial distribution of interstitials and vacancies produced in α-uranium as a result of recoils from direct collisions with fast neutrons is discussed qualitatively. Author

N66-20194# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Electronics.

ON THE ORIGIN OF THE MAGNETOELECTRIC EFFECT OF Cr_2O_3

S. Alexander and S. Shtrikman 1 Dec. 1965 13 p refs (Contract AF 61(052)-654)
(TN-20) CFSTI: HC $1.00/MF $0.50

The importance of the electric field induced g shift to the magnetoelectric effect in Cr_2O_3 is considered. It is argued that only this mechanism can account for the low temperature magnetoelectric effect along the C axis and that at higher temperature the effect is probably due to the change of the intrasublattice exchange with the electric field. Author

N66-20231# Vermont Univ., Burlington.
THE ABSORPTION OF HYDROGEN AND DEUTERIUM BY PALLADIUM-RICH ALLOYS Progress Report, 1 Jun. 1964–1 Jun. 1965
Ted B. Flanagan [1965] 24 p refs
(Contract AT(30-1)-3000)
(NYO-3000-7) CFSTI: HC $1.00/MF $0.50

The statistical mechanical proton absorption model was extended to incorporate the variation of electron donation energy with the density of empty states in Pd. Absorption isotherms and diffusion constants were measured for hydrogen in the alpha phase of Pd. The absorption of hydrogen and deuterium by a series of Au–Pd alloys was measured. Relations between electrical resistivity and hydrogen content were determined for α–Pd and Au–Pd. NSA

N66-20248# California Univ., Berkeley. Lawrence Radiation Lab.
CALCULATIONS OF SURFACE POTENTIAL FOR OXIDE-PASSIVATED HIGH-RESISTIVITY SILICON
R. Y. Deshpande 22 Jun. 1965 9 p refs
(Contract W-7405-ENG-48)
(UCRL-11508) CFSTI: HC $1.00/MF $0.50

The fact that the oxide-passivated surface of high resistivity silicon is characterized by a high density of donor states is taken into account in calculation of the surface potential. Author (NSA)

N66-20250# Dartmouth Coll., Hanover, N. H.
COLOR CENTERS, ENERGY STORAGE, AND THERMOLUMINESCENCE IN LiF CRYSTALS Progress Report, 1 Jan.–30 Sep. 1965
N. M. Johnson and R. W. Christy 30 Sep. 1965 6 p refs
(Contract AT(30-1)-3473)
(NYO-3474-1) CFSTI: HC $1.00/MF $0.50

Studies were made of thermoluminescence between 25 and 300°C and of optical absorption between 190 and 770 mμ. Measurements were made in the lower gamma ray dose range, where thermoluminescence is linear with dose. For the impure LiF samples, the F band (250 mμ) and the 310 and 380 mμ bands are produced, while in pure LiF, only the F band is produced. No bands at 340 or 220 mμ were observed at low doses. The 100 and 200° thermoluminescent peaks were identified with the 380 and 310 mμ bands, respectively. Pulse annealing experiments indicate that the F band is involved in the thermoluminescent process; it may be the thermoluminescent recombination center. Optical bleaching experiments show that the 250, 310, and 380 mμ bands are each bleached by light absorbed in the band itself, but that the 310 and 380 mμ bands are not bleached by 250 mμ light. The possible existence of trapped hole centers is considered. Author (NSA)

N66-20251# California Univ., Livermore. Lawrence Radiation Lab.
DETERMINATION OF THE NUCLEON-NUCLEON ELASTIC SCATTERING MATRIX. II: PHASE-SHIFT ANALYSES OF EXPERIMENTS NEAR 50, 95, 142, 210, AND 310 MeV
Malcolm M. Mac Gregor, Richard A. Arndt, and David S. Bailey 29 Jun. 1964 63 p refs
(Contract W-7405-ENG-48)
(UCRL-7942) CFSTI: HC $3.00/MF $0.75

Phase shift analyses have been carried out for (p,p) and (n,p) experiments at energies near 50, 95, 210, and 310 MeV. Both (p,p) data analyses and combined (p,p) plus (n,p) data analyses were obtained at these energies. Attention was concentrated in all cases on the Stapp type 1 solution, with the objective being to obtain the best possible values for the phase shifts from the existing nucleon-nucleon data. Error matrices were calculated for all solutions, and determinations of the pion-nucleon coupling constant g^2 were carried out. It was found that reasonably consistent values for g^2 can be obtained if a suitable selection of the phenomenological phase shifts is made. The T=1 phase shifts determined from (p,p) data only were found to be in good agreement with the T=1 phase shifts obtained from combined (p,p) plus (n,p) data, thus verifying the gross features of charge independence. For completeness, phase shift values at 142 MeV are included. Author (NSA)

N66-20281# Oak Ridge National Lab., Tenn. Health Physics Div.
OPTICAL PROPERTIES OF VACUUM EVAPORATED FILMS OF CADMIUM, THALLIUM, AND ZINC IN THE VACUUM ULTRAVIOLET
Thomas Milo Jelinek (M.S. Thesis—Vanderbilt Univ.) and E. T. Arakawa Aug. 1965 61 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1164) CFSTI: HC $3.00/MF $0.75

The optical constants of vacuum evaporated films of Cd, Tl, and Zn were determined in the vacuum ultraviolet region from reflectance measurements made for monochromatic light incident at various angles of incidence. These optical constants, n and k, were then used to calculate values of the complex dielectric constant and the energy loss function, $\mathrm{Im}(1/\epsilon)$. The values of the energy loss functions were in good agreement with the characteristic electron energy losses. In addition, the optical constants were used in the transition radiation theory to calculate the optical emission spectra of electron bombarded metal films. The theoretical spectra agree well with those found experimentally. Author (NSA)

N66-20293# California Univ., Livermore. Lawrence Radiation Lab.
STIMULATED BRILLOUIN SCATTERING
J. A. Fleck, Jr. Jul. 1964 24 p refs
(Contract W-7405-ENG-48)
(UCRL-7968-T) CFSTI: HC $1.00/MF $0.50

A quantum mechanical hamiltonian is derived to describe the interaction between a transverse electromagnetic field and the field of acoustic waves in an isotropic solid. The coupling mechanism between the two types of field is the dependence of the dielectric permitivity on density. First order perturbation theory based on this hamiltonian is used to derive Boltzmann or gain-loss equations for the scattered photon and phonon distribution functions. These equations enable a simple and straightforward derivation of the original cross-section formulas of Brillouin for the scattering of light by thermal acoustic waves as well as a determination of the rates of stimulated scattering of light and the associated production of phonons. Conditions, which depend on the power as well as the frequency and angular spread of the laser beam, are derived for the exponential buildup of the scattered beam and associated photon. Author (NSA)

N66-20302# Commissariat a l'Energie Atomique, Grenoble (France).
STUDY OF SUPERCONDUCTORS OF THE SECOND TYPE IN THE LEAD–THALLIUM SYSTEM [ETUDE DES SUPRACONDUCTEURS DE LA DEUXIEME ESPECE DU SYSTEME PLOMB–THALLIUM]
Gilbert Bon Mardion (Ph.D. Thesis) Feb. 1965 77 p refs In FRENCH
(CEA-R-2616)

It is shown by magnetization measurements on Pb–Tl alloys having 5 to 70 atom per cent thallium, that superconductors of the second type definitely exist. The results obtained, in particular on the upper critical field H_{c2}, agree with the models of Ginzburg, Landau, Abrikosov, Gorkov and Goodman. Resistivity measurements confirm the occurrence of a fourth upper critical field, the existence of which has been theoretically predicted. Author (NSA)

N66-20328# Vanderbilt Univ., Nashville, Tenn.
DETERMINATION OF ENERGY GAPS IN SUPERCONDUCTORS BY A NEW TECHNIQUE USING LOW RESISTANCE CONTACTS
Donald Barrett Sullivan (Ph.D. Thesis) May 1965 65 p refs
(Contract AT(40-1)-1087)
(TID-21947) CFSTI: HC $3.00/MF $0.75

Measurements were carried out of the magnetic-field and temperature dependence of the energy gap in several hard superconductors. The temperature dependence is in excellent agreement with the predictions of BCS theory. It is believed that a direct measurement of the magnetic-field dependence of the energy gap in type II superconductors has not been previously reported. A model for very thin contacts between normal metals and superconductors, in reasonable agreement with the observations, is presented. The behavior of several unexplained junction characteristics reported in the literature is almost identical to those reported; the physical situation is sufficiently similar to suggest that the model proposed is applicable. Author (NSA)

N66-20332# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
INVESTIGATION OF THE p-n TRANSITION IN SILICON BY MEANS OF LIQUID ELECTROMAGNETIC DEVELOPER [ISSLEDOVANIE p-n PEREKHODA V KREMNII S POMOSHCH'YU ZHIDKIKH ELEKTROFOTOGRAFICHESKIKH PROYAVITELEI]
A. S. Antonov and L. G. Yuskeselieva 1965 9 p refs In RUSSIAN
(JINR-P-2002)

The p-n transition in Si is studied by means of liquid electrophotographic developer. The concentration of the acceptors in the p-type silicon is determined. The results are similar to those obtained from the specific resistance and from measurements of the capacity of the p-n transition. Author (NSA)

N66-20359# California Univ., Livermore. Lawrence Radiation Lab.
STUDIES OF BAND STRUCTURE AND ELECTRON SCATTERING IN ALUMINUM BY PHOTOEMISSION
F. Wooten, T. Huen, and R. N. Stuart 23 Aug. 1965 17 p refs Presented at Intern. Conf. on Optical and Electron. Properties of Metals and Alloys, Paris
(Contract W-7405-ENG-48)
(UCRL-12470; CONF-650929-1) CFSTI: HC $1.00/MF $0.50

The energy distribution of electrons emitted from aluminum was measured as a function of photon energy in the energy range from 5 to 11.5 eV. The emitted electron energy distribution is almost a replica of the density of occupied states. There is only a small contribution to the energy distribution from electrons which have undergone electron–electron scattering, and some structure in the density of states near the Fermi energy can be resolved. The results are in agreement with both soft X-ray emission data and theoretical calculations. Monte Carlo calculations of the energy distribution and quantum yield were made. The calculations include both electron–electron scattering and electron–phonon scattering. By filtering calculations to experimental results, information on electron scattering cross sections was obtained. The mean free path for electron–electron scattering is about 1000 Å for electrons 6 eV above the Fermi energy. Author (NSA)

N66-20420# Cofnell Univ., Ithaca, N. Y. Materials Science Center.
DIELECTRIC PROPERTIES OF POTASSIUM HALIDES CONTAINING NO_2^- AND NO_3^- IONS.
Michael Moriarty (M.S. Thesis) Feb. 1965 52 p refs
(Contract AT(30-1)-2471)
(NYO-2471-6) CFSTI: HC $3.00/MF $0.50

The real and imaginary part of the dielectric constant of various potassium halides, pure and doped with NO_2^- and NO_3^- ions, were measured in a frequency range from 500 cps to 100 kc and in a temperature interval from 2 to 300°K. Since the NO_2^- ion carries a permanent dipole moment and since the NO_3^- ion may be distorted, due to the crystalline field, to give rise to a dipole moment, contributions to the dielectric constant from the orientational polarizability can be expected and have been observed. In KCl only one orientation contribution was observed, while in KBr and KI several contributions exist. Dipole moments could be calculated, and when the orientation process was a thermally activated one, activation energies could be determined. Author

N66-20437# California Univ., Berkeley. Lawrence Radiation Lab.
DISLOCATION DYNAMICS
J. E. Dorn, J. Mitchell, and F. Hauser 1 Mar. 1965 44 p refs Presented at the 1965 Spring Meeting of the Soc. for Exptl. Stress Analysis
(Contract W-7405-ENG-48)
(UCRL-11977; CONF-650503-2) CFSTI: HC $2.00/MF $0.50

A brief summary is presented on the current status of knowledge regarding the dynamic behavior of crystalline materials in terms of athermal, thermally activated, viscous damping, and relativistic motion of dislocations. It is shown that dislocation concepts have contributed substantially to a better and more unified rationalization of the dynamic behavior of crystalline materials than heretofore possible. Particular emphasis is given to the need for a more complete theoretical understanding of dislocation mechanics. And, the requirements for more detailed and better experiments is expressed particularly for dislocation velocity determinations in the viscous damping and relativistic ranges of conditions.
Author (NSA)

N66-20439# Los Alamos Scientific Lab., N. Mex.
A SIMPLE EXPRESSION FOR THE QUARTIC ANHARMONIC CONTRIBUTION TO THE HELMHOLTZ FREE ENERGY OF A SPECIAL MODEL OF AN F.C.C. CRYSTAL
A. A. Maradudin (Calif. Univ., Irvine) 27 Sep. 1965 9 p refs
(Contract W-7405-ENG-36)
(LA-3379-MS) CFSTI: HC $1.00/MF $0.50

In general, the calculation of the quartic anharmonic contribution F_4 (T) to the free energy of a crystal involves double summation over the Brillouin zone. Thus, its usefulness is often limited because of the enormous amount of numerical work required for its evaluation. However, for many crystals one obtains a satisfactory approximation by considering only nearest-neighbor interactions. For this case, it is shown that F_4 (T) simplifies to an expression involving the square of a single summation over the zone. The proof is for a face-centered cubic crystal. The expression is valid at all temperatures and can be written as an integral over the frequency

spectrum; furthermore, it is unnecessary to calculate the eigenvectors. This result enables simple calculations of the thermodynamic properties corresponding to $F_4(T)$ to be carried out. Author (NSA)

N66-20447# Argonne National Lab., Ill.
THE IR-SPECTRUM OF THE U-CENTER
G. Schaefer (Thesis) June 1965 19 p refs Transl. into ENGLISH from Phys. Chem. Solids, v 12, 1960 p 233–244
(ANL-TRANS-206)

The infra-red vibration absorption of a point imperfection in alkali halides, the U-center, was measured. The frequency ν corresponding to the absorption maximum depends upon the lattice spacing and, in a first approximation, is given by the equation $h\nu d^2 = \text{const}$. For the examined crystals, the wavelength of the absorption maximum lies in the range between 17.75μ (NaCl) and 27.65μ (RbI). The absorption lines show a marked narrowing if the crystal is cooled from room temperature to 57°K. The half width decreases to about one tenth and is then of the order of magnitude 10^{-3} eV. For KCl and KBr at low temperatures, an oscillator strength of about 0.5 could be determined. Author (NSA)

N66-20491# Los Alamos Scientific Lab., N. Mex.
ELECTRONIC BAND STRUCTURES OF PLUTONIUM AND ITS MONOCARBIDE
E. A. Kmetko and J. T. Waber [1965] 31 p refs Presented at the 3d Intern. Conf. on Plutonium, London, 22–26 Nov. 1965
(Contract W-7405-ENG-36)
(LA-DC-7353; CONF-651102-9) CFSTI: HC $2.00/MF $0.50

The band structure of delta-phase plutonium was calculated by the tight binding and Augmented Plane Wave methods. The band width, density of states curve, and the Fermi surface were obtained from these calculations. The width of the 5f bands from the tight binding results is in better agreement with the width Kmetko deduced from a heuristic study than with that deduced from the Augmented Plane Wave results. The width of the 5f band in PuC was found by the tight binding method to be about two-thirds as large as that in delta-phase plutonium. Author (NSA)

N66-20500# California Univ., Berkeley. Lawrence Radiation Lab.
DETERMINATION OF THE ORDERING IN THE INTERMETALLIC COMPOUND Ag_2Al BY MEANS OF X-RAYS
Joachim P. Neumann (Ph.D. Thesis) 28 Jan. 1965 63 p refs
(Contract W-7405-ENG-48)
(UCRL-11928) CFSTI: HC $3.00/MF $0.75

In order to verify the predicted short-range ordering in the intermetallic hexagonal phase Ag_2Al, the diffuse intensity diffracted from single crystals of this alloy was measured in several directions in reciprocal space. On crystals annealed for 10 days at 453°K, the first Cowley-Warren pair-density coefficient was found to be approximately −0.20. The tendency toward the formation of a two-dimensional superlattice on the basal planes is indicated, in which each aluminum atom is surrounded by six silver atoms. The measurements were carried out in vacuum at approximately 300°K and 150°K, using crystal monochromated MoK_α-radiation. The proposed model of the superlattice is based on the appearance of short-range order peaks at 1/3 and 2/3 the distance from the (110) line. Weak but sharp lines of the type (001), (003) can be explained by an average composition difference of 1 at. % in consecutive basal planes, extending over many layers. No explanation can yet be given for the simultaneous existence of long-range and short-range order. The c-parameter of the annealed alloy was found to be 0.06A larger than the value reported for the quenched alloy, indicating a different atomic arrangement in the two states. Author (NSA)

N66-20577# Notre Dame Univ., Ind.
AN EXPERIMENTAL DETERMINATION OF THERMODYNAMIC AND ELECTRICAL PROPERTIES OF STRONTIUM ON TUNGSTEN
R. H. Dittman, A. A. Petrauskas, and E. A. Coomes [1965] 66 p refs Presented in part at the 12th Field Emission Symp., Pennsylvania State Univ., 7–11 Sep. 1965
(Contract Nonr-1623(01))
(AD-627081) CFSTI: HC $3.00/MF $0.75

The field electron microscope was used for the precise determination of thermodynamic and electrical properties of Sr adsorbed on W. For Sr coverages above theta nearly equal to 0.70 the Sr adlayer exhibits bulk properties. Below theta nearly equal to 0.20 Sr is probably adsorbed in the ionic state. Between theta nearly equal to 0.20 and theta nearly equal to 0.70 there is a mixture of ionic surface properties and bulk properties in the adsorbed Sr. At a characteristic, or isokinetic temperature of 1350K the rate of thermal desorption of Sr from W is independent of Sr coverage theta. Author (TAB)

N66-20690# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
INVESTIGATION OF THE MAGNETIC SMALL-ANGLE SCATTERING OF SLOW NEUTRONS AT DISLOCATIONS IN NICKEL
A. Stork, J. Christ, and W. Schmatz Jul. 1965 13 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 18, no. 5-6, 1965 p 468–471
(AERE-TRANS-1040) HMSO: 2s 6d

Magnetization near dislocations is heterogeneous owing to a magnetic elastic coupling mechanism. As Kronmüller, Seeger and Wilkens have shown, this effect causes small-angle scattering which is appreciably greater than the scattering from non-magnetic materials. Small-angle scattering has been measured for cold-worked nickel as a function of magnetic field and scattering angle. The intensity gives the dislocation density, and measurements with different fields and scattering angles enable the mean dislocation distance to be calculated. Author

N66-20726# Iowa State Univ. of Science and Technology, Ames. Institute for Atomic Research.
FIFTH RARE EARTH RESEARCH CONFERENCE. BOOK ONE: SPECTRA SYMPOSIUM SESSION S-1 AND SPECTRA SESSION S-2
1965 158 p refs Conf. held 30-31 Aug. 1965
(Grant AF-AFOSR-812-65)
(AFOSR-65-1917, Bk. 1; AD-627221) CFSTI: HC $5.00/MF $1.00

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N66-20737 Varian Associates, Palo Alto, Calif.
OPTICAL AND PHYSICAL PROPERTIES OF SINGLE CRYSTAL LANTHANUM TRIFLUORIDE
Hugh M. Muir and William Stein *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 1: Spectra Symp. Session S-1 and Spectra Session S-2 [1965] p 123–136 refs (See N66-20726 10-26) CFSTI: HC $5.00/MF $1.00

Optical and physical measurements made on high purity single crystal LaF_3 indicate its potential as a valuable optical window material. The excellent transmission over a very broad spectrum extending from ~1300 Å in the vacuum ultraviolet to ~13 μ in the intermediate infrared, coupled with a high degree of chemical and physical stability, makes LaF_3 extremely attractive for a wide range of optical applications. Some of the critical purification and crystal growth conditions necessary for the synthesis of the high purity, optical grade LaF_3, as well as the optical and physical parameters, are presented. Author

N66-20741# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
FIFTH RARE EARTH RESEARCH CONFERENCE. BOOK TWO: SOLID STATE SESSION P-1
[1965] 112 p refs Conf. held 30–31 Aug. 1965
(Grant AF-AFOSR-812-65)
(AFOSR-65-1917, Bk. 2; AD-627222) CFSTI: HC $4.00/MF $0.75

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11. VALENCE BOND FORMATION IN THE CLOSE-PACKED RARE EARTH METALS F. L. Carter (NRL) p 103–113 refs (See N66-20751 10-26)

N66-20742 Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
INITIAL SUSCEPTIBILITY INVESTIGATION OF MAGNETIC TRANSITIONS IN SEVERAL RARE EARTH METALS: THERMAL HYSTERESIS IN FERROMAGNETIC TRANSITIONS
F. J. Jelinek, E. D. Hill, and B. C. Gerstein *In its* 5th Rare Earth Res. Conf. Book 2: Solid State Session P-1 [1965] p 1-14 refs (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

Thermal hysteresis of magnetic transitions in polycrystalline Gadolinium, Terbyum, Dysprosium, Holmium, Thulium and Samarium have been investigated by an a.c. mutual inductance magnetic susceptibility technique. A thermal hysteresis effect was observed in the ferromagnetic transitions of Tb, Dy, Ho and Tm. No thermal hysteresis was observed in the magnetic transitions of Gd and Sm. Author

N66-20743 Brookhaven National Lab., Upton, N. Y.
DISTRIBUTION OF MAGNETIC MOMENT DENSITY IN Tb
O. Steinsvoll (Kjeller Res. Estab.), G. Shirane, R. Nathans, H. A. Alperin, and S. J. Pickart (Naval Ordnance Lab.) *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 2: Solid State Session P-1 [1965] p 15–22 refs Prepared in cooperation with Naval Ordnance Lab. Sponsored by AEC (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

The magnetic form factor of metallic terbium has been measured at 4.2°K by scattering of polarized neutrons with wavelength λ=0.8 Å from single crystal samples. Using a split coil superconducting magnet giving a field of 40K Oe across the crystal it was possible to magnetize the samples close to saturation along both the a- and the b-directions, the latter being the direction of easy magnetization. The overall agreement with theoretical calculations for the Tb_3+ ion form factor is satisfactory. The experimental points were found to lie on a smooth curve which is consistent with the theoretical prediction that the terbium magnetic moment density has a disc-shaped distribution normal to the resultant moment direction. Author

N66-20744 Naval Ordnance Lab., White Oak, Md.
MAGNETOSTRICTION IN THE HEAVY RARE EARTH METALS
B. F. De Savage and A. E. Clark *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 2: Solid State Session P-1 [1965] p 23–34 refs (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

It was found that the magnetostrictive strains in single crystals of the heavy rare earth metals Tb, Dy, and Er are extraordinarily large (10−3 to 10−2) at low temperatures. When these strains are combined group theoretically with spin-operators which transform according to the irreducible representations of the hexagonal group, it is observed that the lowest order magnetostrictive strains arise primarily from single-ion terms in the interaction Hamiltonian and hence have a temperature and field dependence given by a simple function of the magnetic moment. Assuming the deformable-ion model, Tsuya, Clark, and Bozorth predict the 0°K values of these strains $\lambda(0)$ from the strained charge distribution of the conduction electrons. The extrapolated 0°K values of the shear magnetostriction, taking Dy as 100, were found to be 117, 100, 28, and −44 for Tb, Dy, Ho, and Er, respectively. Author

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N66-20745 International Business Machines Corp., Zurich (Switzerland). Zurich Research Lab.
OBSERVATION OF OPTICAL ABSORPTION BANDS ASSOCIATED WITH MAGNETIC ORDER IN RARE-EARTH METALS
C. C. Schüler *In* Iowa State Univ. of Res. and Technol. 5th Rare Earth Res. Conf. Book 2: Solid State Session P-1 [1965] p 35–44 refs (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

Spectroscopic studies of Gd metal reflexion methods have revealed an absorption band in the infrared, centered at 0.4 eV, which appears in the ferromagnetically ordered state below 289°K. The strength of the absorption increases with increased order as the temperature is lowered. A similar band is present in Dy metal in the spiral-phase below 178°K and persists into the ferromagnetic phase below 85°K. The nature of these extra absorptions is not yet understood. An earlier explanation on the basis of magnetic superzones present in the antiferromagnetic phases of Dy and Ho must now be abandoned, since it does not apply to ferromagnetic order. Author

N66-20746 General Electric Co., Schenectady, N. Y. Research Lab.
INFRARED ABSORPTION STRUCTURE IN RARE EARTH METALS: RELATIONSHIP TO SPIN ARRANGEMENT AND BAND STRUCTURE
B. R. Cooper and R. W. Redington *In* Iowa State Univ. of Res. and Technol. 5th Rare Earth Res. Conf. Book 2: Solid State Session P-1 [1965] p 45–53 refs (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

A definitive experiment is described for determining whether any part of the infrared absorption, from 0.25 to 0.85 eV, of rare earths is associated with the spiral periodicity. Based on this experiment it is concluded, for dysprosium, that infrared absorption is completely independent of spiral periodicity. An alternative explanation, based on band calculations, is offered for the occurrence of low frequency optical structure in the heavy rare earths. D.T.

N66-20747 International Business Machines Corp., Zurich (Switzerland). Zurich Research Lab.
ELECTRON-SPINWAVE SCATTERING IN GADOLINIUM
B. Lüthi and H. Rohrer *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 2: Solid State Session P-1 [1965] p 55–61 refs (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

The electrical resistivity due to magnetic scattering in polycrystalline gadolinium has been determined in the temperature range between 4.2°K and 25°K. The part of the resistivity due to scattering by domains and magnetic impurities is practically independent of temperature, whereas that due to spin-wave scattering follows a $T^{3.1\pm0.2}$ law and is considerably smaller than the resistivity due to phonon scattering. The temperature dependence of the latter varies between $T^{2.8}$ and $T^{3.5}$. Author

N66-20748 United States Steel Corp., Monroeville, Pa. Edgar C. Bain Lab. for Fundamental Research.
THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF SAMARIUM AT LOW TEMPERATURES
Sigurds Arajs and G. R. Dunmyre *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 2: Solid State Session P-1 [1965] p 73–74 refs (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

Thermal conductivity and electrical resistivity of samarium have been measured from 5° to 200°K and from 5° to 300°K, respectively. Two anomalies, one at 12°±1°K and another at 106° ±1° K, are observed, resulting from an order–order magnetic transformation and an antiferromagnetic–paramagnetic transition, respectively. The Lorenz function is found to be larger at any temperature than that expected for pure electronic thermal conductivity. This implies that there is some phonon and possibly also some magnon thermal conductivity in samarium at low temperatures. The magnetic moment disorder electrical resistivity of samarium is determined to be 39.0±0.5 $\mu\Omega$cm, in fair agreement with the value to be expected from theoretical considerations. Author

N66-20749 Los Alamos Scientific Lab., N. Mex. Sandia Corp., Albuquerque, N. Mex.
RESULTS OF AUGMENTED PLANE WAVE CALCULATIONS OF THE BAND STRUCTURE OF CERIUM METAL
J. T. Waber and A. C. Switendick (Sandia Corp.) *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 2: Solid State Session, P-1 [1965] p 75–87 refs Sponsored by AEC Prepared in cooperation with Sandia Corp. (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

Ten sets of electronic band structure calculations were performed for cerium metal by using the augmented plane wave method for five configurations of the type $6s^2 5d^x 4f^{2-x}$ and the lattice constants appropriate to the FCC gamma and FCC alpha phases. It is shown that the location of the f band is strongly dependent on the atomic configuration assumed in starting the calculation. The relation of these results to previous atomic calculations is discussed. It is believed that the bands should not be occupied to a common energy level according to a simple Fermi-Dirac distribution, but rather that

the 4 electrons outside the xenon core should be arranged in the f as well as in the s and d bands so as to be reasonably consistent with the configuration assumed. As a consequence the f-band location is dependent on the degree to which it is occupied. The two-electron calculations by Waber, Liberman and Cromer of the total energy for a cerium atom confined to a Wigner-Seitz sphere lend further support to this assignment hypothesis. Author

N66-20750 Bell Telephone Labs., Inc., Murray Hill, N. J.
HIGH PRESSURE POLYMORPHISM AND MAGNETIC ORDERING IN SOME Sm-TYPE RARE EARTH ALLOYS AND SAMARIUM
A. Jayaraman, R. C. Sherwood, and E. Corenzwit *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 2: Solid State Session P-1 [1965] p 91–102 refs (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

The rare earth alloys LaY, PrY, NdY, NdTm and $LaGd_3$ all of which crystallize in the Sm-type structure undergo a pressure-induced phase change to the double hexagonal close packed structure (La-type); the high pressure phase is metastably retained at atmospheric pressure. However, under similar pressure and temperature treatment CeY decomposes to the elements. Magnetic data are presented for the normal and high pressure phases of NdTm, $LaGd_3$ and Sm; in the latter case the data are from earlier measurements. The significance of the breakdown of CeY and the anomalies in the low temperature magnetization data of $LaGd_3$, NdTm and Sm are discussed. Author

N66-20751 Naval Research Lab., Washington, D. C.
VALENCE BOND FORMATION IN THE CLOSE-PACKED RARE EARTH METALS
Forrest L. Carter *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf. Book 2: Solid State Session P-1 [1965] p 103–113 refs (See N66-20741 10-26) CFSTI: HC $4.00/MF $0.75

A modified valence bond (VB) treatment of the close-packed metals has been developed subject to the restrictions that: (1) all near neighbors are bound simultaneously; (2) equivalent atoms form equivalent bonds; and (3) certain periodic boundary conditions. The use of bidirectional orbitals having the general characteristics $ap_x+\sqrt{1-a^2}\ d_{xy}$ give rise to various phase structures involving cycles of old VB theory. In the ccp and hcp structures this leads to a natural division of the electrons and orbitals into those associated with: (1) a band of covalent bonds; (2) a MO band having s-character for free electrons; and (3) localized orbitals not directed toward near neighbors and suitable for containing unshared electrons. Author

N66-20767# Iowa State Univ. of Science and Technology, Ames.
FIFTH RARE EARTH RESEARCH CONFERENCE, AUGUST 30, 31, SEPTEMBER 1, 1965. BOOK FOUR: SOLID STATE SESSION P-2
Washington, AFOSR [1965] 109 p refs
(Contract AF-AFOSR-812-65)
(AFOSR-65-1917, Bk.-4; AD-627224) CFSTI: HC $4.00/MF $0.75

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2. MAGNETIC PROPERTIES OF RARE-EARTH CARBIDES MC_{1-x} R. Lallement (Comm. a l'Energ. Atomique) p 11–18 refs (See N66-20769 10-26)

3. SUPERCONDUCTING LANTHANIUM CHALCOGENIDES R. M. Bozorth, F. Holtzberg, and S. Methfessel (IBM) p 19–30 refs (See N66-20770 10-26)

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5. ELECTRICAL CONDUCTION AND DIELECTRIC PROPERTIES OF CERAMIC AND SINGLE CRYSTAL CERIUM OXIDE C. J. Kevane, E. L. Holverson, and J. B. Armstrong (Ariz. State Univ.) p 43–54 refs (See N66-20772 10-26)

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7. RARE EARTH TUNGSTEN BRONZES W. Ostering (AFSC, Wright-Patterson AFB) p 67–78 refs (See N66-20774 10-17)

8. FLUORINE-FREE FLUX FOR GROWTH OF RARE EARTH GARNETS M. Schieber (MIT) p 79–88 refs (See N66-20775 10-26)

9. FERROMAGNETISM IN DILUTE SOLUTIONS OF RARE EARTHS IN PALLADIUM J. Crangle and R. B. Layng (Sheffield Univ.) p 89–100 refs (See N66-20776 10-26)

10. THERMAL ANOMALIES AND THERMODYNAMIC PROPERTIES OF GADOLINIUM HEXABORIDE E. F. Westrum, Jr., J. T. S. Andrews (Michigan Univ.), and G. A. Clay (Little (Arthur D.) and Co., Inc.) p 101–108 refs (See N66-20777 10-26)

N66-20768# Pittsburgh Univ., Pa. Dept. of Chemistry.
MAGNETIC CHARACTERISTICS OF Pr COMPOUNDS HAVING THE ROCK-SALT STRUCTURE
T. Tsuchida and W. E. Wallace *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 4: Solid State Session P-2 [1965] p 1–8 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75
(NYO-3454-5)

The magnetic behavior of PrP, PrAs, PrSb and PrBi has been investigated over the temperature range extending from 4 to 300°K. Curie-Weiss behavior is observed for all compounds in the upper portion of the temperature range studied with effective moments in fair agreement with those expected for the free tripositive ions. There is no indication of magnetic ordering; at low temperatures, however, the compounds exhibit Van Vleck (temperature-independent) paramagnetism. This is attributed to the influence of the crystal field in splitting the 9-fold degenerate ground state of the free Pr^{+3} ion. The susceptibility-temperature behavior of PrSb and PrBi can be accounted for in terms of a single parameter from which overall crystal field splittings of 157 and 140 cm^{-1}, respectively are deduced. Similar attempts for PrP and PrAs were unsuccessful. Results for the Pr compounds are in sharp contrast with those obtained for the corresponding Ce and Nd compounds. Author

N66-20769 Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
MAGNETIC PROPERTIES OF RARE-EARTH CARBIDES MC_{1-x}
R. Lallement *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965 Bk. 4: Solid State Session P-2 [1965] p 11–18 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75

In order to determine precisely the Neel and Curie-Weiss temperatures, and the magnetic moments, the magnetic susceptibility of rare earth carbides of the MC_{1-x} type was meas-

ured at low temperatures. Preliminary results indicate that the carbides underwent magnetic transitions. Also, in order to determine the variation of the coupling constant for magnetic ions and conduction electrons, the Curie-Weiss temperature was studied as a function of carbon content. It is concluded that the band structure of the rare earth carbides is approximately the same as the metal band structure. All experiments were conducted with holmium carbide. D.T.

N66-20770# International Business Machines Corp., Yorktown Heights, N. Y. Watson Research Center.
SUPERCONDUCTING LANTHANUM CHALCOGENIDES
R. M. Bozorth, F. Holtzberg, and S. Methfessel *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 4: Solid State Session P-2 [1965] p 19–30 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75

The lanthanum chalcogenides, LaSe, LaS, La_3Se_4, and La_3S_4, have been investigated for superconductivity above 1.3° K by magnetic susceptibility measurements. The following transition temperatures T_c were derived from the temperature dependence of the frozen-in magnetic flux, La_3S_4:6.5° K, La_3Se_4:8.6° K; La_3Te_4, LaS, and LaSe are not superconducting above 1.3° K. The 3:4 compounds have a wide homogeneity range with the Th_3P_4 structure and the electrical properties vary with decreasing La concentration from metallic to semiconducting without change of lattice constant. The superconducting transition temperature in La_3Se_4 decreases initially by about 5° K for each at.% decrease in La. Author

N66-20771 Systems Analysis Staff, Naval Ordnance Lab., Silver Spring, Md.
THE MAGNETIC SUSCEPTIBILITY OF RARE EARTH OXIDES BELOW 4.2°K
R. E. Brown and W. M. Hubbard *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965 Bk. 4: Solid State Session P-2 [1965] p 31-42 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75

The magnetic susceptibility of the cubic sesquioxides of Yb, Tm, Er, Ho, Dy, Tb, and Gd has been measured at temperatures from 1.3° to 4.2°K in applied fields ranging from a few gauss to 6 kilogauss. No evidence has been found for magnetic ordering in Gd_2O_3, Dy_2O_3 or Tm_2O_3, but the effect of the crystal field on the susceptibility is prominent. The magnetic field dependence of the differential susceptibility of Er_2O_3 and Ho_2O_3 suggests that field induced rearrangements occur in the magnetic ordering. The magnetic field required to move the Neel point to zero temperature in Er_2O_3 and Tb_2O_3 has been deduced to be 17 kilogauss and 7 kilogauss respectively. Author

N66-20772 Arizona State Univ., Tempe. Dept. of Physics.
ELECTRICAL CONDUCTION AND DIELECTRIC PROPERTIES OF CERAMIC AND SINGLE CRYSTAL CERIUM OXIDE
C. J. Kevane, E. L. Holverson, and James B. Armstrong *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 4: Solid State Session P-2 [1965] p 43–54 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75
(Grants AF-AFOSR-602-64; AF-AFOSR-62-130)

Studies of electrical conduction in ceramic and single crystal cerium oxide were carried out over a temperature range from 250° to 1500° C. The studies involved two- and four-contact dc measurements of conductivity and ac bridge measurements of dielectric constant and dielectric loss in the audio frequency range. Composition changes were made by varying oxygen partial pressure between 1.0 and 10^{-4} atm. When calcium impurities were present, the results showed appreciable conduction by oxygen ions below 600°C. The dielectric constant of ceramic cerium oxide was found to be strongly frequency dependent; the dielectric loss factor showed pronounced peaks in both ceramic and single crystal samples. The four-contact dc conductivity varied from $10^{-2}(\text{ohm-cm})^{-1}$ at 1500° C down to $10^{-1}(\text{ohm-cm})^{-1}$ at 250° C. The conductivity dependence on oxygen partial pressure indicated n-type conduction at temperatures above 1200°C. Below 1200°C the logarithmic plot of conductivity against oxygen partial pressure showed well-defined minima and indicated regions of p-type conduction which were confirmed by the sign of Seebeck coefficient. Author

N66-20773# Northwestern Univ., Evanston, Ill. Dept. of Materials Service.
DIELECTRIC AND MECHANICAL LOSSES DUE TO CALCIUM-OXYGEN VACANCY PAIRS IN CERIUM DIOXIDE
K. W. Lay and D. H. Whitmore *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, p 55-66 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75
(Contracts Nonr-1228(16); NR-032-459)

Measurements of dielectric losses and internal friction in Cadoped CeO_2 have been made over the temperature range 25° to 200°C on samples with up to 2.5 percent of the Ce^{4+} ions replaced by Ca^{2+} ions. The dielectric loss measurements were made using frequencies up to 10,000 cps with the aid of a capacitance bridge, whereas the internal friction measurements were made using a low frequency reed pendulum. A model has been postulated to explain these observations involving oxygen vacancy-Ca^{2+} dipoles which tend to orient themselves when subjected to the alternating electrical or mechanical strain field, the dipoles following the field with a certain time lag thereby giving rise to the observed relaxation losses. In this model, the loss-factor attains a maximum if the applied frequency of the field equals the jump frequency of the oxygen ion vacancy. From the temperature dependence of the relaxation times and the peak shape, the activation energy required for such oxygen vacancy jumps is calculated to be 0.86 ev, with the pre-exponential factor estimated to be $2.4\times10^{14}\text{sec}^{-1}$. Author

N66-20775 Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
FLUORINE-FREE FLUX FOR GROWTH OF RARE EARTH GARNETS
M. Schieber *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 4: Solid State Session P-2 [1965] p 79–88 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75

A composition diagram which compares various mixtures used for growing rare earth garnets is described. The flux components of $PbO\text{-}B_2O_3$ or $PbO\text{-}PbF_2$ recommended for growth of either rare earth iron, gallium, or aluminium garnets are expressed in terms of a pseudoternary diagram. The crystals discussed are $Eu_3Fe_5O_{12}$, $Eu_3Ga_5O_{12}$, $Tm_3Al_5O_{12}$, $Tm_3Ga_5O_{12}$, $Yb_3Ga_5O_{12}$, and $Yb_3Fe_2Ga_3O_{12}$. The crystals are characterized by lattice constant, morphology, and in some cases, by magnetic susceptibility data. Author

N66-20776 Sheffield Univ. (England). Dept. of Physics.
FERROMAGNETISM IN DILUTE SOLUTIONS OF RARE EARTHS IN PALLADIUM
J. Crangle and R. B. Layng *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 4: Solid State Session P-2 [1965] p 89–100 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75

Ferromagnetic ordering occurs at low temperatures in dilute solid solutions of many of the rare earth elements in palladium, and the magnetic coupling between the rare earth local moments appears to be via polarization of the matrix. The direction of the moment associated with the matrix opposes that of the rare earth spins. New experimental data are presented on the magnetization and paramagnetic susceptibility of these alloys. Author

N66-20777 Michigan Univ., Ann Arbor. Dept. of Chemistry.
THERMAL ANOMALIES AND THERMODYNAMIC PROPERTIES OF GADOLINIUM HEXABORIDE
Edgar F. Westrum, Jr., John T. S. Andrews, and Gerald A. Clay *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 4: Solid State Session P-2 [1965] p 101–108 refs (See N66-20767 10-26) CFSTI: HC $4.00/MF $0.75

Studies on the thermal properties of lanthanum and neodymium hexaborides, in the cryogenic region, have been made on gadolinium hexaboride and cerium hexaboride. Like the neodymium compound the gadolinium shows a cooperative transition apparently associated with antiferromagnetic ordering, with a peak at 16°K. Moreover, a Schottky effect, presumably occasioned by the second-order interaction of the crystalline field, with the spin-orbit coupling vector, has a maximum heat capacity at 29°K. The Schottky effect is attributed to quadruply and doubly degenerate levels, separated by 145 and 230 cal./mole, above the doubly degenerate ground state. The contribution from the Schottky level at 25°C is $R \ln 4$, and that associated with the magnetic cooperative transition approximates $R \ln \gamma$ as would be expected for the complete order of the $(2s+1)$ levels associated with the spin, $s=7/2$, of the Gd(III) ion. Thermodynamic functions for GdB_6 are derived on the basis of these values. Author

N66-20780 Birmingham Univ. (England). Dept. of Physical Metallurgy.
ELECTRONIC STATES OF RARE-EARTH METALS IN ALLOYS
G. V. Raynor *In* Iowa State Univ. of Sci. and Tech. Fifth Rare Earth Res. Conf., Aug. 30, 31, Sep. 1, 1965. Bk. 5: Met. Session M [1965] p 1–12 refs (See N66-20779 10-17) CFSTI: HC $4.00/MF $1.00

Results of experimental work, i.e., mainly lattice spacing determinations, on solid solutions of certain rare-earth metals with thorium, zirconium and yttrium, and with each other, are briefly discussed. It is suggested that solute metals with complex electronic configurations, such as the rare-earths, transition and transuranic elements, are capable of changing this configuration on alloying according to environment. In particular, cerium, when subjected to compressive strain energy of solution, tends to contract by ionization of the 4f electron. In other circumstances a tendency to change its effective valency towards that of the solvent is observed. Similar tendencies are found in intermediate phases. The Laves phases of the cubic C15 type are of particular interest, since both electronic and atomic size relationships between the components may be widely varied. Recent results are briefly discussed. Author

N66-20792# Iowa State Univ. of Science and Technology, Ames. Institute for Atomic Research.
FIFTH RARE EARTH RESEARCH CONFERENCE. BOOK SIX: SOLID STATE SESSION P-3
[1965] 80 p refs Conf. held 30 Aug.–1 Sep. 1965
(Grant AF-AFOSR-812-65)
'AFOSR-65-1917, Bk. 6; AD-627226) CFSTI: HC $3.00/MF $0.75

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3. EXPERIMENTAL STUDY OF THE EXCOTATIONS IN RARE-EARTH METALS A. R. Mackintosh p 17–20 refs (See N66-20794 10-26)

4. THE INDIRECT EXCHANGE INTERACTION IN THE RARE EARTH METALS F. Specht (Rice Univ.) p 21-28 refs (See N66-20795 10-26)

5. EFFECTS OF DILUTE RARE-EARTH ADDITIONS ON THE ELECTRICAL CONDUCTIVITY OF CERIUM AT LOW TEMPERATURES F. W. Clinard, R. O. Elliott, and W. N. Miner (Los Alamos Sci. Lab.) p 29–42 refs (See N66-20796 10-26)

6. SPIN DEPENDENCE OF THE ELECTRICAL RESISTIVITIES OF GADOLINIUM ALLOYS C. W. Chen (Westinghouse Elec. Corp.) p 43–50 refs (See N66-20797 10-26)

7. MAGNETIC TRANSFORMATION IN HEAVY RARE-EARTH ALLOYS WITH EACH OTHER R. M. Bozorth and R. J. Gambino (IBM) p 51–62 refs (See N66-20798 10-26)

8. PARAMAGNETIC STUDIES OF HOLMIUM BY NEUTRON TOTAL CROSS SECTION MEASUREMENTS M. Mattos (Inst. de Energ. Atomica) 15 p refs (See N66-20799 10-26)

N66-20793 Osaka Univ. (Japan).
SOME THEORETICAL ASPECTS OF HEAVY RARE EARTH METALS
Takeo Nagamiya *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf., Bk. 6. Solid State Session P-3 [1965] p 5–16 refs (See N66-20792 10-26) CFSTI: HC $3.00/MF $0.75

The band structure for the conduction electrons and its consequence on the magnetic and electric properties of heavy rare earth metals are discussed. A brief description of the theory of the magnetization processes of a helical spin arrangement, in particular structure changes from helix to fan and then to ferromagnetic alignment with increasing magnetic field, is presented, the temperature being assumed to be finite and a sixfold anisotropy within the easy plane being included. Further, spin waves in a helical arrangement and in a fan arrangement are discussed; uniform modes and their frequencies are particularly considered. Author

N66-20794 Iowa State Univ. of Science and Technology, Ames.
EXPERIMENTAL STUDY OF THE EXCITATIONS IN RARE-EARTH METALS
A. R. Mackintosh *In its* 5th Rare Earth Res. Conf., Bk. 6. Solid State Session P-3 [1965] p 17–20 refs (See N66-20792 10-26) CFSTI: HC $3.00/MF $0.75

Experimental developments in the study of conduction electrons and spin wave interactions from the magnetic ground state are reviewed. Based on the angular correlation of photons emitted when positrons annihilate electrons, measurements made on single crystals of holmium showed that the Fermi surface is highly anisotropic. This is in agreement with the anomalously high electronic specific heat, band structure calculations, and the fact that electrical resistivity is temperature and magnetic field dependent. Despite limitations in the form of high thermal neutron capture cross section, inelastic neutron scattering is suggested as a method of measuring the magnon dispersion curves in order to gain information on spin waves; magnetic resonance measurement is suggested as an alternative technique when the limitations are too great

to overcome. It is also pointed out that some information may be derived on conduction electrons and their spin wave interactions from the study of transport properties. D.T.

N66-20795 Rice Univ., Houston, Tex.
THE INDIRECT EXCHANGE INTERACTION IN THE RARE EARTH METALS
Frederick Specht *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf., Bk. 6. Solid State Session P-3 [1965] p 21–28 refs. Sponsored by NASA (See N66-20792 10-26) CFSTI: HC $3.00/MF $0.75

An exact calculation is given for the indirect exchange interaction in the rare earth metals. With a free electron gas model for the conduction band the isotropic and first order non-isotropic terms are obtained, and it is shown that the non-isotropic term gives sizeable contributions to the interaction between two ions. An estimate is made of the contribution of the anisotropy to the crystalline exchange energy for the ferromagnetic phase. The two ferromagnetic ordering patterns with moments along the c-axis and in the hexagonal plane are considered, and an energy difference in agreement with experiment is found to be of the order of ten per cent. Author

N66-20796 Los Alamos Scientific Lab., N. Mex.
EFFECTS OF DILUTE RARE-EARTH ADDITIONS ON THE ELECTRICAL CONDUCTIVITY OF CERIUM AT LOW TEMPERATURES
F. W. Clinard, R. O. Elliott, and W. N. Miner *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf., Bk. 6. Solid State Session P-3 [1965] p 29–42 refs Sponsored by AEC (See N66-20792 10-26) CFSTI: HC $3.00/MF $0.75

Two atomic percent of the various trivalent rare earths were dissolved in cerium, and the electrical resistivities of these dilute binary alloys evaluated in the range 1.5° to 297° K, in order to determine whether the various solute magnetic properties might be reflected in resistivity measurements. It was found that the γ and β phases at room temperature showed a roughly linear dependence of resistivities on atomic number of solute species, with a slight effect attributed to solute–solvent atomic size mismatches. At 4° C the resistivities of predominantly α phases were found to be influenced by the presence of small amounts of β, and predominantly β phases by small amounts of α. Spin-disorder resistivities for β phase were found to be a nearly linear function of atomic number of solute, and did not clearly reflect the influence of any solute magnetic parameters. A slight decrease in spin-disorder resistivities was noted in the direction of the heavier rare earth solutes. Author

N66-20797 Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
SPIN DEPENDENCE OF THE ELECTRICAL RESISTIVITIES OF GADOLINIUM ALLOYS
C. W. Chen *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf., Bk. 6. Solid State Session P-3 [1965] p 43–50 refs (See N66-20792 10-26) CFSTI: HC $3.00/MF $0.75
(Contract AF 49(638)-1245)

The electrical resistivities of various intra-rare-earth alloys of gadolinium at 4.2°, 77°, and 298° K are discussed with respect to the theory. Two spin effects are shown in the scattering of the conduction electrons. Author

N66-20798 International Business Machines Corp., Yorktown Heights, N. Y. Watson Research Center.
MAGNETIC TRANSFORMATION IN HEAVY RARE-EARTH ALLOYS WITH EACH OTHER
R. M. Bozorth and R. J. Gambino *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf., Bk. 6 Solid State Session P-3 [1965] p 51–62 refs (See N66-20792 10-26) CFSTI: HC $3.00/MF $0.75

The Curie (T_C) and Neel (T_N) points of the binary intra-rare-earth alloys Gd–Lu, Dy–Ho, Dy–Tm, Er–Tm, and Tm–Lu were measured. There are maxima in the Curie point vs composition curves for Ho–Er, Ho–Tm, and Er–Tm, minima for Dy–Tm and Ho–Tm, when the average concentration of 4f electrons is near 10.5. The Tm–Lu alloys are ferromagnetic when Tm-rich, and distilled Tm has a Curie point, Néel point, and intermediate transformation point. The Lu-rich alloys are all non-ferromagnetic in low fields and some become ferromagnetic at a critical field, when they have sharply increased susceptibility with onset of hysteresis. Representative data for various alloy systems are shown to deviate only slightly from a straight line when plotted against the 2/3 power of the average de Gennes factor. Author

N66-20799 Instituto de Energia Atomica, Sao Paulo (Brazil). Nuclear Div.
PARAMAGNETIC STUDIES OF HOLMIUM BY NEUTRON TOTAL CROSS MEASUREMENTS
Marieta Mattos *In* Iowa State Univ. of Sci. and Technol. 5th Rare Earth Res. Conf., Bk. 6. Solid State Session P-3 [1965] 15 p refs (See N66-20792 10-26)
(IEA-99) CFSTI: HC $3.00/MF $0.75

The total neutron cross section for holmium was measured for neutron wavelengths between 0.20 and 9.00 Å. A crystal spectrometer was used together with a mechanical velocity selector to eliminate higher order reflections from the crystal. Powder samples of Ho_2O_3 were prepared in high purity, taking particular care to eliminate contamination by the rare earths of high neutron cross section. Although paramagnetic form factors are usually determined by differential cross section measurements with one neutron wavelength, accurate total cross section measurements for a wide range of known wavelengths give definite information on the radius of the 4f electron orbits. Our measurements indicate a radius different from the one used by Blume, Freeman and Watson, who calculated the form factor assuming hydrogenic wave functions. The possible choice of different screening constant will be discussed. Author

N66-20810# Naval Ordnance Lab., Corona, Calif.
EMITTANCE STUDIES OF III-V COMPOUND SEMICONDUCTORS, MAY 1963–JUNE 1964
Donald L. Stierwalt and Roy F. Potter 9 Nov. 1965 32 p refs (NOLC-630; AD-626411) CFSTI: HC $2.00/MF $0.50

The report presents a brief discussion of thermal emission and absorption processes, including Planck's radiation function; Kirchhoff's law, which equates the emittance with the absorptance of a sample; and the interrelationships between the emittance, and the transmittance of a sample. Expressions are given for the emittance in three situations: (1) an almost transparent sample; (2) a completely opaque sample; and (3) intermediate situations. Experimental results include direct emittance studies on the III-V compound semiconductors, InP, AlSb, GaAs, GaSb, InAs, InSb, GaP, and AlAs. In addition, certain of the results have been reduced to the intrinsic optical property, the absorption coefficient. In the discussion of results, particular emphasis is given to the fundamental lattice absorption region, known as the reststrahlen frequency, and to multiple-phonon processes. These latter processes result in characteristic absorption spectra, whose features are assigned to certain critical points in the Brillouin zone. As a result, reliable estimates of the phonon dispersion for certain symmetry directions can be made. Author (TAB)

N66-21011*# TRW Systems Group, Redondo Beach, Calif.
HIGH DIELECTRIC CONSTANT THIN FILM CAPACITOR MATERIALS STUDY Interim Report
R. P. Radke 25 Mar. 1966 88 p refs
(Contract NAS9-5592)
(NASA-CR-65300) CFSTI: HC $3.00/MF $0.75 CSCL 20L

General properties of ferroelectric materials and antiferroelectricity are discussed as part of an effort towards studying thin film capacitor materials of the ABO_3 type. The bulk properties of titanates (barium, lead, strontium, and calcium), zirconates (barium, strontium, and calcium), hafnates, stannates, niobates (potassium, sodium, cadmium, and lead), tantalates, tungsten trioxide, and antimony sulfur iodide are discussed. Various data relating to their physical and electrical properties are graphically depicted. L.S.

N66-21037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF IONIZING RADIATION ON RUBY
Americo F. Forestieri and Hubert H. Grimes Washington, NASA, Apr. 1966 11 p refs
(NASA-TN-D-3379) CFSTI: HC $0.15/MF $0.50 CSCL 20L

The ability of ruby to operate as a laser is dependent on the presence of chromium^{+3} (Cr^{+3}) impurity ions. Since radiation can cause severe ionization effects in ionic solids, it is desirable to determine whether ruby would be affected by such a radiation field. High-purity ruby and α-aluminum oxide (α-Al_2O_3) were studied by optical absorption and electron paramagnetic resonance techniques both before and after irradiation with high-energy X-rays. Irradiation of ruby crystals which have been preannealed in air results in a 20-percent loss of Cr^{+3}, the formulation of Cr^{+4} and Cr^{+6} ions, and an unidentified V-type defect center. The effects found indicate complex interactions which depend strongly on the crystal pretreatment, purity, and irradiation dose. Probable ionization processes are given to account for the results observed. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-19976# Tracor, Inc., Austin, Tex.
ELECTROCHEMICAL STUDIES IN THE SYNTHESIS OF N-F COMPOUNDS Quarterly Status Report No. 11, 1 Jul.–30 Sep. 1965
Larry G. Spears, Larry D. Fiel, and James L. Lindgren 5 Jan. 1966 23 p refs
(Contract Nonr-4054(00); ARPA Order 399)
(TRACOR-66-104-U; AD-626211) CFSTI: HC $1.00/MF $0.50

The electrolysis of NH_4F in anhydrous HF at various concentrations and anode potentials was studied. If water is present in the electrolyte, the proportion of N_2F_2 is decreased and OF_2 and NF_3 are increased. It is apparent that water has a large effect on the electrode reactions and thus cannot be used as a passivator to decrease attack of the anode during electrochemical fluorinations. Additional studies were made to determine the conditions required for passivation of electrodes in liquid HF electrolytes. Author (TAB)

N66-20830# California Univ., Livermore. Lawrence Radiation Lab.
THE DEVELOPMENT OF PLASTIC BONDED EXPLOSIVES
Edward James 29 Apr. 1965 15 p Presented at the Am. Ordnance Assoc., Propellants and Explosives Sect. Meeting, Yorktown, Va.
(Contract W-7405-ENG-48)
(UCRL-12439-T; CONF-650516-1) CFSTI: HC $1.00/MF $0.50

The development of a PBX is based on formulating principles emobyding considerations of performance, handling and operational sensitivity, chemical and thermal stability, physical or mechanical properties and manufacturing. The history of the development of several important PBXs, 9007, 9407, 9010, 9404, and LX-04-1, is presented along with a discussion of the formulating considerations used to arrive at the final composition. Comparative properties are presented along with suggestions of application in different ordnance items. PBX 9404 is an example of an explosive in which energy density is maximized and so is highly brisant; PBX 9407 is very sensitive to shock initiation and so is important for booster applications. Author (NSA)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N66-19871# Williams Research Corp., Walled Lake, Mich.
APPLICATION OF EXTENDED PLUG NOZZLE NOISE SUPPRESSION THEORY TO A SMALL TURBOJET ENGINE Technical Report
H. B. Moore and J. M. Clinch 7 Aug. 1965 199 p refs
(Contract FA-64-WA-5062)
(FAA-ADS-56)

The effectiveness of extended plug nozzles in reducing jet engine exhaust noise was investigated on small scale hot and cold nozzles and on a small turbojet engine. The investigation included: (1) Optimization of geometry for the small nozzles on the basis of noise reduction vs thrust loss which provided the criteria for design of the nozzles tested on the engine. (2) Engine noise and thrust tests with a conventional thrust nozzle and extended plug nozzles on the WR2-2 engine under simulated fanjet as well as pure turbojet operation. (3) Attempts to correlate small scale cold flow noise measurements with engine noise data. (4) Attempts to explain observed noise reductions on a theoretical basis. Author

N66-19923# Aerojet-General Corp., Sacramento, Calif.
GEMINI STABILITY IMPROVEMENT PROGRAM (GEMSIP). VOLUME 3: ANALYTICAL MODEL Final Report
W. J. Nord ed. 31 Aug. 1965 204 p refs For abstract see N66-19925 10-28
(Contract AF 04(695)-517)
(GEMSIP-FR-1; SSD-TR-66-2; AD-626766) CFSTI: HC $6.00/MF $1.25

N66-19924# Aerojet-General Corp., Sacramento, Calif.
GEMINI STABILITY IMPROVEMENT PROGRAM (GEMSIP). VOLUME 2: DEVELOPMENT TEST PROGRAM Final Report
W. J. Nord, ed. 31 Aug. 1965 466 p refs
(Contract AF 04(695)-517)
(GEMSIP-FR-1; SSD-TR-66-2; AD-626767) CFSTI: HC $7.70/MF $2.00

The report is devoted to an intensive review of the full-scale test firing portion of the program—the preparation of test plans, design and fabrication of test hardware, the testing, and the interpretation of test data. Also included in this volume are those nonfiring tests that were conducted with full-scale hardware for obtaining specific injector parameters necessary for reducing the hot-fired data. TAB

N66-19925# Aerojet-General Corp., Sacramento, Calif.
GEMINI STABILITY IMPROVEMENT PROGRAM (GEMSIP). VOLUME I: SUMMARY Final Report
W. J. Nord, ed. 31 Aug. 1965 192 p refs
(Contract AF 04(695)-517)
(GEMSIP-FR-1; SSD-TR-66-2; AD-626768) CFSTI: HC $5.00/MF $1.00

The Gemini Stability Improvement Program (GEMSIP) was undertaken to provide a dynamically stable injector for the Stage II Gemini engine to improve the prospects for pilot safety and mission success. The criterion for dynamic stability was that the injector continue to operate stably after pulsing with explosive changes in the thrust chamber and with acoustic shocks in the feed system. This was accomplished and demonstrated by a series of 72 engine tests. Improvements were made in injector fabrication. Advanced fabrication techniques were investigated that are applicable to many aerospace components. Improvements were made in high frequency instrumentation, particularly in regard to cooled combustion chambers. Two unique pressure sensing methods were investigated and improved. A data processing system was developed for handling and analyzing large amounts of high frequency data. Experimental methods were developed for direct measurement of gas side wall temperatures and improvements were made in pulsing techniques. In combustion theory the Sensitive Time Lag Theory was extended to nonlinear conditions and generalized. An improved method was developed for predicting altitude performance. Author (TAB)

N66-20078*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF TWO-STAGE AIR-COOLED TURBINE SUITABLE FOR FLIGHT AT MACH 2.5
Harold J. Schum, Donald A. Petrash, and Robert R. Nunamaker Washington, NASA, Nov. 1959 53 p refs
(NASA-TM-X-148) CFSTI: HC $3.00/MF $0.50 CSCL 21E (Declassified)

The over-all component performance characteristics of an experimental two-stage turbine, designed to power a turbojet engine suitable for a flight Mach number of 2.5, were determined for a range of speed and pressure ratio at inlet conditions of 35 inches of mercury absolute and 700° R. A phase of the experimental program was conducted at the design equivalent speed and over a range of pressure ratio, in which the turbine performance was evaluated with various amounts of cooling air being effused from the first- or second-stage-rotor blade tips, or both. For the uncooled turbine, the brake internal efficiency at equivalent design speed and work was 0.922. The corresponding equivalent turbine weight flow was 3 percent greater than the design value of 42.88 pounds per second. In general, the turbine yielded high efficiencies over a wide range of equivalent speed and pressure ratio. When cooling air was employed at the equivalent design speed, the turbine efficiency decreased with increasing amounts of air effusion from either rotor blade row. At the rating pressure ratio, 3.07, results indicate that turbine efficiency would be no less than 0.903. Author

N66-20085*# Texas A&M Research Foundation, College Station.
IMPROVEMENT OF PROPELLER STATIC THRUST ESTIMATION Final Report, Jul. 1, 1964–Aug. 31, 1965
A. E. Cronk and Joseph C. Brusse Jan. 1966 39 p refs Revised
(Grant NsG-669)
(NASA-CR-70942) CFSTI: HC $2.00/MF $0.50 CSCL 21G

The development of experimental facilities for the measurement of thrust and torque of model propellers operating in the static thrust condition is described. Techniques for flow visualization upstream and downstream of the plane of rotation of the propeller are described. A theoretical method for calculation of the inflow velocity field and propeller wake contraction is summarized. A computer program for numerical calculations following this theory is described. Author

N66-20570# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIQUID FUEL INJECTOR
I. Ye. Ul'yanov and N. S. Lamekin 28 Sep. 1965 7 p Transl. into ENGLISH from Russian Patent no. 123375 (Appl. no. 576744/25, 12 Jan. 1956) 2 p
(FTD-TT-65-1011/1+2+4; AD-627068) CFSTI: HC $1.00/MF $0.50

A fuel injector which uses ultrasonic vibration to assure atomization is presented. The atomization process is independent of the fuel feed pressure. A pneumatic generator in the form of a volumetric resonator provided with a slit acts as the ultrasonic vibrator. TAB

N66-20596# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TURBINE COMBUSTION ENGINES IN ENERGETICS
Jerzy Grzegorzewski 9 Dec. 1965 8 p Transl. into ENGLISH from Przegl. Tech. (Warsaw), no. 52, 1964 p 1,4
(FTD-TT-65-1175/1+4; AD-476120)

The use of turbine combustion engines as power sources for electric power stations is discussed, and the value of using turbine engines for industrial purposes is assessed. The projects toward the development of turbine engines in the Soviet Union are reviewed and the problems which impede their development are summarized. H.S.W.

N66-20681# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
MALFUNCTION OF IGNITERS IN THE AMRA VARIABLE PARAMETER ROCKET ENGINE
Anthony K. Wong and James Brown Jul. 1965 19 p refs
(AMRA-TN-65-06; AD-626273) CFSTI: HC $1.00/MF $0.50

Three firing tests on nozzles were rendered unsatisfactory due to malfunctioning of the pyrotechnic igniters. These igniters were off-the-shelf manufacturer's items. Failure of the igniters was manifested by the leakage of hot gases through the squib end of the igniter body case, followed by complete erosion of that element resulting in a deleterious decrease in chamber pressure and extension of burning time. Although the igniters were several years old, the manufacturer did not believe that aging was the problem. Subsequent examination of the igniters indicated the presence of corrosion of the electrical lead wire immediately adjacent to the ceramic seal en-

closing the primer charge. In order to minimize further mishaps, the manufacturer replaced the primer charge unit in all of the igniters remaining on hand. Author (TAB)

N66-20714# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTON REACTION ENGINE
Ye. S. Fridenson 11 Jan. 1966 17 p Transl. into ENGLISH from Vestn. Protivovozd. Obor. (Moscow), no. 9, 1964 p 67–71
(FTD-TT-65-1815/1+2+4; AD-626975) CFSTI: HC $1.00/MF $0.50

Operating principles of the engine and prospects of its creation are discussed. TAB

N66-20766# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).
LOSS OF THRUST IN NOZZLES OF ROCKET ENGINES CAUSED BY SKIN FRICTION AND NON-AXIAL DISCHARGE AT A HIGH EXPANSION RATIO [SCHUBVERLUST IN DUSEN VON RAKETENTRIEBWERKEN DURCH WANDREIBUNG UND NICHTAXIALE AUSSTROMUNG BEI HOHEM EXPANSIONSVERHALTNIS]
W. Buschulte and W. Hartung Nov. 1965 78 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-58) CFSTI: HC $3.00/MF $0.75

A theoretical investigation of the nozzle efficiency of rocket engines is described in detail. The calculation is based on the momentum equation of the boundary-layer. The determination of the effects of various parameters, as size and geometry of the nozzle, combustion chamber condition and propellant combination is particularly considered. The results obtained can be used for selecting optimal operating conditions for rocket engines with respect to nozzle efficiency. Author

N66-20819# Hiller Aircraft Corp., Palo Alto, Calif.
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM. VOLUME II: PARAMETRIC DESIGN STUDY
Ft. Eustis, Va., Army Aviation Mater. Labs., Oct. 1965 104 p refs *Its* Eng. Rept.-64-42
(Contract DA-44-177-AMC-25(T))
(USAAVLABS-TR-64-68B; AD-625819) CFSTI: HC $4.00/MF $0.75

The parametric analysis determines the optimum design parameters of a 24,000-lb.-payload helicopter powered by turbojet engines installed at the rotor blade tips. The method used determined a gross weight which would satisfy statistical component weight equations and aerodynamic equations simultaneously. The optimizing criterion was the minimum gross weight required to perform a specific mission. The results of the analysis indicate that the optimum configuration using the Continental Model 357-1 engine is a helicopter with (a) four blades, (b) two engines per blade, and (c) with a generalized or 'rubber' engine is a helicopter with (a) three blades, (b) one engine per blade, and (c) a crane type fuselage. Author (TAB)

N66-20823# Hiller Aircraft Corp., Palo Alto, Calif.
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM. VOLUME IX: PERFORMANCE ANALYSIS
Ft. Eustis, Va., Army Aviation Mater. Labs., Oct. 1965 73 p refs *Its* Eng. Rept.-64-49
(Contract DA-44-177-AMC-25(T))
(USAAVLABS-TR-64-68I; AD-625821) CFSTI: HC $3.00/MF $0.75

The report presents a performance and characteristics summary of the Model 1108 tip turbojet-powered heavylift helicopter. The configuration was selected from a parametric analysis (USAAVLABS Technical Report 64-68B). Standard performance methods are used, modified where necessary by factors peculiar to tip turbojet propulsion. Author (TAB)

N66-21013*# Vickers Inc., Troy, Mich. Research and Development Dept.
DESIGN AND DEVELOPMENT OF AN INTEGRATED SIXTY POUND THRUST CHAMBER Final Report
J. A. Berst and M. Mudryk 24 Apr. 1963 203 p
(Contract NAS9-554)
(NASA-CR-65308; TR-2-8) CFSTI: HC $6.00/MF $1.25 CSCL 21H

Detailed reports on the design and development of an integrated pulse modulated thrust chamber that produces a thrust of 60 lb±3% when operated continuously are presented. A response of less than 0.010 sec measured from the time rated current is applied to the solenoid to the instant the output thrust equals 80% of rate thrust, was achieved. It was determined that nitrogen tetroxide should be the oxidizer; that the fuel should be a 50/50 mixture of hydrazine and UDMH; that the combustion chamber pressure should be 150 psia; that the inlet pressure to the injector valve should be 240 psia; that the pressure differential across the propellant injector should be 75 psi; that the efficiency of the combustion chamber should be about 95%; that the minimum pulse bit attainable be 0.60 lbs-sec; that the pulse rocket be designed for minimum weight and size compatible with a high degree of reliability; and that the electrical power to operate the solenoid should be 17 watts maximum. Other design recommendations are also made, based on materials and components testing. Calibration curves, instrumentation, and schematic diagrams are given. Gas to liquid leakage conversion; vacuum equipment; and solenoid and linkage train parameters are also described. L.S.

N66-21036*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF PROPELLANT INJECTION VELOCITY ON SCREECH IN 20,000-POUND HYDROGEN-OXYGEN ROCKET ENGINE
John P. Wanhainen, Harold C. Parish, and E. William Conrad Washington, NASA, Apr. 1966 31 p refs
(NASA-TN-D-3373) CFSTI: HC $0.45/MF $0.50 CSCL 21H

Thirteen concentric tube injectors were evaluated: nine configurations with conventional straight-bore oxidizer elements, two configurations with taper-reamed oxidizer elements, one configuration with counterbored oxidizer elements, and one configuration with recessed oxidizer elements. Stability data were obtained at a chamber pressure of 300 pounds per square inch absolute and over a range of oxidant-fuel ratios from 4 to 7. Hydrogen injection temperature was used to rate the stability of the various designs. The injector with the lowest self-triggering temperature was considered to be the most stable design. The hydrogen temperature at which screech occurred could be reduced to less than 60°R (minimum available) by selection of hydrogen-to-oxygen injection area ratios of less than one. The combustion stability boundary correlated with hydrogen-to-oxygen injection velocity ratio irrespective of the hydrogen temperature level; at a velocity ratio above 6 1/2 combustion was stable and below 6 1/2, unstable. The stable operating limits of both the tapered and counterbored oxidizer element configurations correlated with data of conventional injectors when based on exit area ratio. Recessing the oxidizer tubes below the surface of the faceplate also improved the stability. Author

N66-21075*# Boeing Co., Seattle, Wash. Space Div.
VOYAGER SPACECRAFT SYSTEM. VOLUME C: ALTERNATE DESIGNS CONSIDERED FOR SPACECRAFT PROPULSION SYSTEMS Final Technical Report, Task B
Jan. 1966 245 p Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71510; D2-82709-8) CFSTI: HC $6.00/MF $1.50 CSCL 21H

Candidate concepts considered were solid/liquid systems sized both for the 1971 and 1973 missions and the 1975 and 1977 missions, the Apollo Lunar Excursion Module descent propulsion system, and the Titan III-C transtage. Propulsion system tradeoffs and analyses leading to a selection of the preferred propulsion design for the Voyager Mars 1971 mission are presented. Also described are: (1) the optimized candidate propulsion systems and their competing characteristics; (2) trade studies leading to the optimum candidate propulsion designs; and (3) an assessment of the preferred design. It is pointed out that in conducting the tradeoffs, velocity requirements and weight allocations presented in the Voyager 1971 preliminary mission description were used. Candidate propulsion designs for the 1971 mission were sized for a 3000-pound capsule, which slightly penalizes the performance of the solid/liquid designs. A solid/liquid system sized for a 3000-pound capsule can accommodate a 2000-pound capsule without redesign. Similarly, it was found that candidate solid/liquid designs for the 1975 and 1977 missions were sized for a 10,000-pound capsule. R.R.D.

N66-21082*# General Electric Co., Philadelphia, Pa.
VOYAGER SPACECRAFT SYSTEM, PHASE IA. TASK B: PRELIMINARY DESIGN. PROPULSION SYSTEM ANALYSIS. VOLUME C
31 Jan. 1966 177 p Prepared for JPL
(Contracts WAS7-100; JPL-951112)
(NASA-CR-71500; DIN-65SD4514, Vol. C) CFSTI: HC $5.00/MF $1.00 CSCL 21H

This volume contains the results of a systems study relating to the applicability of several types of propulsions systems for the VOYAGER Missions. The emphasis of the study was on overall Spacecraft System considerations affecting preferred propulsion systems for the VOYAGER Planetary Vehicle. In particular, the propulsion, configuration, and guidance and control subsystems of the spacecraft were considered in overall tradeoffs. The propulsion systems studied include: (1) a solid propellant engine used for orbit insertion, combined with a separate variable impulse multistart system for midcourse and orbit correction maneuvers; (2) the Apollo Lunar Excursion Module Descent Engine (LEMDE) system for all Planetary Vehicle maneuvers; (3) the Titan III C Transtage, used for orbit insertion, trajectory correction, and orbit trim maneuvers; and (4) modifications to the Titan III C Transtage configuration to reduce the overall length of the Planetary Vehicle. Early in the study, it became evident that substantial modifications to all existing propulsion systems would be required in order to satisfy VOYAGER requirements. Consequently, the study was expanded to include a modified Apollo Lunar Excursion Module Descent Engine (LEMDE) system in the evaluation. This system employed LEMDE components (thrust chamber and tanks) repackaged into a more satisfactory configuration for the VOYAGER Planetary Vehicle. The final selection was a solid propellant engine for orbit insertion and four hydrazine monopropellant engines for midcourse and orbit adjust maneuvers. The spacecraft configuration for the preferred design is shown. The solid propellant engine recommended is a modification of the Wing 6 Minuteman Stage 2 engine. Author

N66-21097*# Michigan State Univ., East Lansing.
SHOCK TUBE DETERMINATION OF THE DRAG COEFFICIENT OF SMALL SPHERICAL PARTICLES
Bruce P. Selberg Washington, NASA, Apr. 1966 102 p refs
(Grant NsG-86)
(NASA-CR-418) CFSTI: HC $1.50/MF $0.75 CSCL 21H

An experimental study was conducted to determine the drag coefficient of inert spherical particles accelerating in a laminar, non-reacting, incompressible continuum flow. The Reynolds number range which was covered in the study was from 150 to 1700, and particle sizes ranged from 150μ to 450μ. The convective flow behind the shock wave in a shock tube was used to accelerate the particles. The particle's diameter and the displacement versus time measurements were obtained using a rotating drum camera in conjunction with an oscillating light source. The photographic data, the particle density, the shock speed, and the initial pressure and temperature in conjunction with the normal shock relations were combined to calculate the drag coefficient. The drag coefficient is usually considered to be a function only of Reynolds number and acceleration modulus, however, C_D varies considerably because of particle roughness. Experiments with HP 295 ball powder, whose surface is relatively rough, produced results which were as much as 85 per cent higher than the steady state curve, with the increase dependent upon the relative Mach number of the flow about the particle. Similar drag coefficient experiments with smooth sapphire balls did not produce the scatter, the higher values, nor the dependence on relative Mach number. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-19794# High Altitude Observatory, Boulder, Colo.
STANDARDIZED SOLAR FLARE DATA 1959 THROUGH 1961
Constance S. Warwick 15 Feb. 1966 358 p refs IGY Solar Activity Rept. Ser. No. 33

Detailed information is tabulated for all of the solar flares observed between 1959 and 1961 by the World Data Center. Reports that refer to the same flare are identified on the basis of time and position, and combined to give mean values of occurrence time, position, and corrected importance and area. Beginning and end times of each period when no flare patrol was reported to be in operation are listed chronologically among the flare reports. In addition to the overall tabulations, separate listings are included of flares with mean corrected importance $\geq$2- and $\geq$3-. M.W.R.

N66-19833 Radio Corp. of America, Princeton, N. J. Radiation Physics Group.
SPACE RADIATION—ITS INFLUENCE ON SATELLITE DESIGN
A. G. Holmes-Siedle *In its* Space Electron. [1965] p 24–30 refs (See N66-19827 10-31)

Designing electronic equipment to withstand the damaging effect of radiation is an intricate problem in itself, but add this to the problem of designing a light-weight, complex spacecraft which must operate for at least six months in the relatively unknown, ever-changing space radiation environment, and the task becomes enormous. Each part must be considered separately, taking into account not only the expected radiation dosage but also the application and criticality of the component. This paper reviews some of the currently known information about this complex environment and establishes some general guidelines for designing electronic equipment for reliable operation in space. Author

N66-20124# RAND Corp., Santa Monica, Calif.
ON THE SCATTERING OF SUNLIGHT INTO PLANETARY SHADOW CONES
R. C. Moore and G. F. Schilling Dec. 1965 27 p refs Presented at the Symp. on Interdisciplinary Aspects of Radiative Energy Transfer, Philadelphia, 24–26 Feb. 1966
(P-3282; AD-625260) CFSTI: HC $2.00/MF $0.50

Refraction and multiple scattering of solar radiation in a planetary atmosphere cause the propagation of appreciable amounts of radiative energy into the planet's geometric shadow cone. The implications of this atmospheric phenomenon to research in various fields are discussed. Examples are studies of lunar eclipses, the presence of the Venus ring near inferior conjunction, the astronomical problem of the appearance of the earth as a planet, and the flights of spacecraft in earth orbit and in cislunar space. It is shown that the results of such studies can provide data in disciplines involving geophysics, planetary atmospheres, solar physics, astronomy, and astronautics. Rigorous solutions of radiative transfer problems in a real atmosphere, however, still are beyond the capabilities of present theory. Some preliminary quantitative results in the visible range of the electromagnetic spectrum have been obtained through the use of a semiempirical method. This technique promises to become a useful tool in the fields of study discussed. Author (TAB)

N66-20190# France. Direction de la Meteorologie Nationale, Paris.
SOLAR WINDS RECORDED IN EURE-ET-LOIR [LES VENTS AU SOL ENREGISTRES EN EURE-ET-LOIR]
A. David Oct. 1965 55 p refs In FRENCH *Its* Monograph No. 47
CFSTI: HC $3.00/MF $0.50

Surface wind averages based on data taken from 1954 through 1963 are given for the Chateaudun and Chartre airports, in terms of monthly, seasonal, and yearly distributions. The averages are complemented by a study of the daily wind maximums, and of the incidence of violent winds. In addition, an experimental statistical method is described for computing an average from selected observations. Transl. by D.T.

N66-20195 Academy of Science (USSR), Moscow.
PROBLEMS OF RADIATION SAFETY OF SPACE FLIGHTS
Yu. M. Voynkin, P. P. Saksonov, V. V. Antipov, and I. A. Savenko [1966] 16 p
CFSTI: HC $1.00/MF $0.50

The main problems of radiation safety of space flights are discussed: (1) investigation of physical parameters of cosmic radiation—the spectrum of components and their energies, determination of ionizing radiation in space and in time, etc.; (2) determination of relative biological effectiveness of individual components of cosmic radiations; (3) elucidation of specific contribution of cosmic radiation to the biological effect of space flight factors; (4) investigation of the effect of cosmic radiation on heredity and variability of organisms; (5) determination of admissible limit radiation doses for space flights; (6) development of methods of dosimetry of ionizing radiations aboard space vehicles; (7) development of effective means of physical and pharmacochemical protection of organisms against radiations; and (8) prediction of radiation situation in outer space; selection of orbits least dangerous in radiation aspect. Author

N66-20591# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
EFFECT OF THE INTERPLANETARY MAGNETIC FIELD ON SOLAR NEUTRON-DECAY PROTONS
E. C. Roelof Nov. 1965 51 p refs Presented to the Am. Geophys. Union, Dallas, 3 Sep. 1965
(DI-82-0484; AD-625824) CFSTI: HC $3.00/MF $0.50

Upper bounds, placed on steady-state and pulse (flare) outflow of neutrons above 1 MeV from the sun, are obtained by assuming that the neutron-decay protons diffuse in the interplanetary magnetic field in order to calculate the resultant proton fluxes from simple diffusion theory, and then comparing the theoretical fluxes with recent proton observations. Using the IMP-1 proton spectrum (20-75 MeV) it is shown that there is no significant contribution to the inner belt proton population in that energy range by steady neutron outflow in the first half of 1964, and perhaps as far back as 1961. For the same period and energy range, it is concluded that there could have been no higher steady outflow from the sun than 10^{22} neutrons sec^{-1} MeV^{-1}. It is found that neutron-decay protons are insensitive indicators of the presence of neutrons in solar flares. On the order of 10 percent of flare particles at energies 1 to 100 MeV could be neutrons and yet their decay protons would cause only marginally observable modifications of the primary proton flux during the times of diffusion behavior at 1 AU, 0.5 AU, and 1.5 AU. Author (TAB)

N66-21096*# General Dynamics/Convair, San Diego, Calif.
ADAPTION OF EVOLUTIONARY PROGRAMMING TO THE PREDICTION OF SOLAR FLARES
Lawrence J. Fogel, Alvin J. Owens, and Michael J. Walsh Washington, NASA, Apr. 1966 110 p refs
(Contract NAS5-3907)
(NASA-CR-417) CFSTI: HC $1.35/MF $0.75 CSCL 20H

Application of an evolutionary programming technique to the prediction of solar flares is discussed. Evolutionary programming was originally devised as an alternative means for addressing some fundamental problems of artificial intelligence. In contrast to the bionic approach and heuristic programming, evolutionary programming does not attempt to replicate human performance, either biological or psychological. Instead, attention is focused upon the logic of Darwinian evolution as a means for generating a suitable logic for overcoming a wide variety of problems, as witness the survival of living organisms. The advent of high speed digital computers makes such replication practicable. Evolutionary programming was first restricted to problems of predicting binary environments. Demonstration of a considerable level of success in predicting certain difficult environments, such as the primeness of each successive positive integer, justified offering evolutionary programming as means for the prediction and analysis of real-world time series. The program and the fundamental concepts involved are described in detail. M.R.W.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-19863# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
DEVELOPMENT OF A METHOD FOR METEOR TRAJECTORY ANALYSIS
L. Moulin and J. Develay Nov. 1965 45 p refs
(Grant AF-EOAR-65-12)
(VKI-TN-31) CFSTI: HC $2.00/MF $0.50

Analysis of meteor trajectories has been viewed as a means to improve the knowledge about aerodynamic heating during atmospheric re-entry, for velocity ranges beyond escape velocity. A method of analysis is presented herein. Application to one natural meteor known as Meanook 132 has been made and the results compared with those obtained by other methods. Author

N66-19930 Tohoku Univ., Sendai (Japan). Geophysical Inst.
HEIGHT PROFILES OF DENSITY, COMPOSITION, AND IONIZATION IN THE MARTIAN ATMOSPHERE
Hiroshi Kamiyama *In its* Sci. Rept. of the Tohoku Univ. Feb. 1965 p 1-14 refs (See N66-19929 10-13) CFSTI: HC $3.00/MF $0.50

With a particular assumption for the vertical temperature distribution and the chemical composition of the lower atmosphere, a possible model of the Martian atmosphere is deduced on the terrestrial analogy. On the assumption that, at the surface, the pressure is 85 mb and the air is composed of 2.2% CO_2 and 97.8% N_2, the photodissociation of CO_2 takes place in the region above 128 km, and peaks of the concentration occur at 137 km for O and at 132 km for CO and O_2. Diffusion is considered to be important above 150 km. Two ionospheric layers are formed by the ionization of N_2, O, and O_2, the lower layer being located at about 135 km and the upper at a level between 600 km and 900 km. The maximum electron concentration is about 4×10^4 cm^{-3} in the lower layer and between 9×10^4 and 1.8×10^5 cm^{-3} in the upper layer. The height variation of the ion composition is also described. Author

N66-19975*# Arizona State Univ., Tempe. Coll. of Engineering Sciences.
ATTITUDE STABILITY OF A SPINNING PASSIVE SATELLITE IN A CIRCULAR ORBIT Semiannual Technical Progress Report, 1 Jun. 1965-30 Nov. 1965
Leonard Meirovitch Dec. 1965 58 p refs
(Grant NGR-03-001-014)
(NASA-CR-70781) CFSTI: HC $3.00/MF $0.50 CSCL 22B

The stability of motion of a satellite orbiting the earth is being investigated. The mathematical model consists of a rigid body with two flexible antennas. A simplified model uses two viscously damped oscillators to simulate the antennas. The motion is described by ten generalized coordinates of which three are used for the motion of the center of the rigid body, three for the angular rotations of the body and four for the displacements of the oscillators. This investigation is concerned with the possibility that the motion in which the body undergoes no rotation with respect to the orbiting frame of reference is stable. To this end the direct method of Liapounov is used for the case in which the center of the rigid body is constrained to move in a circular orbit as well as for the unconstrained case. The conclusion is that the orbital constraints assumption is not valid. Stability criteria have been derived for three equilibrium configurations which are intimately related to the gravity-gradient stabilization case for the rigid body. Author

N66-20045# Czechoslovak Academy of Sciences, Prague.
ASTRONOMICS YEARBOOK 1966 [HVEZDARSKA ROCENKA 1966]
Jiri Bouska, Vladimir Guth, and Bedrich Onderlicka 1965 236 p refs In Czechoslovakian *Its* Yearbook No. 42

Studies and progress are reported in the following areas: (1) fundamental astronomy; (2) celestial mechanics; (3) solar phenomena; (4) moon, planets, and planetoids; (5) comets and meteors; (6) stars, double stars, and star clusters; (7) interstellar substances; (8) cosmic radiation; (9) evolution of stars; (10) extragalactic composition; (11) quasars; and (12) metagalaxies. Also included are calendar data, positions of astronomical bodies, a review of astronomical time signals, and the coverage of the various time zones. Transl. by D.T.

N66-20049 Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
ATTITUDE CONTROL OF A FLEXIBLE, SPINNING, TOROIDAL MANNED SPACE STATION
William B. Gevarter Nov. 1965 224 p refs
(Grant NsG-133-61)
(NASA-CR-70859; SUDAER-250) CFSTI: HC $6.00/MF $1.25 CSCL 22A

This study considers a continuous attitude-control system for controlling the direction of the spin axis of a flexible, spinning, toroidal manned space station. The basic objectives was to find locations within the space station for the control actuators (forces or moments) and attitude sensors such that the space station is stable and the excitation of vibration by the control system is at a minimum. When flexure is considered, these locations are of the utmost importance since they determine the coupling of the flexural motions with the rigid-body motion to be controlled. The flexural frequencies and mode shapes of the spinning space station were determined analytically. Then the rigid-body equations of angular motion about axes in the plane of the toroid were transformed into a single vector equation in the body-fixed frame, and a suitable two-axis linear feedback control system was chosen. Applying the general stability relations to the spinning space station made it possible to observe the influence of the locations of the control actuators and sensors on station stability. The results thus obtained were verified using a computer program. Author

N66-20070*# Space Technology Labs., Inc., Redondo Beach, Calif.
A UNIVERSAL FORMULATION FOR CONIC TRAJECTORIES. BASIC VARIABLES AND RELATIONSHIPS
Jack E. Brooks and William W. Lemmon Feb. 1965 97 p refs
(Contract NAS9-2938)
(NASA-CR-71184; STL-3400-6019-TU-000) CFSTI: HC $3.00/MF $0.75 CSCL 03C

Some of the fundamental relations for inverse-square motion are reviewed and expressions for various conic trajectory quantities are obtained by using a particular independent variable. This variable is proportional to the eccentric anomaly

or its hyperbolic counterpart but is defined universally and remains determinant for all values of the eccentricity. Conic relations are developed in terms of a special set of functions which replace the standard circular and hyperbolic trigonometric functions. The resulting universal formulation is not only valid for all values of the eccentricity but also for the case of rectilinear motion as well. G.G.

N66-20077*# TRW Systems, Redondo Beach, Calif.
THEORETICAL INVESTIGATION: THE SCATTERING OF LIGHT BY A PLANETARY ATMOSPHERE Interim Report, 22 Sep.–22 Dec. 1965
Robert S. Fraser [1965] 26 p refs
(Contract NAS5-9678)
(NASA-CR-70943; TRW-4520-6001-RO-000) CFSTI: HC $2.00/MF $0.50 CSCL 03B

A theoretical study of the characteristics of radiation scattering in a planetary atmosphere was conducted. It is shown that the lower boundary of the atmosphere reflects radiation specularly according to Fresnel's law. The following investigations are reported: (1) the accuracy of the computed x and y functions of Chandrasekhar; (2) the albedo of diffuse sky light from both smooth and rough water surfaces; and (3) the characteristics of the neutral points which refer to the directions where the degree of polarization of light from the atmosphere vanishes. D.T.

N66-20128*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
ORBITAL TRANSFER BY OPTIMUM THRUST DIRECTION AND DURATION
Stephen A. Jurovics 12 Feb. 1964 44 p refs
(Contract NAS8-5211)
(NASA-CR-71027; SID-64-24) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A three dimensional derivation is presented of the equations and boundary conditions necessary to determine the minimum fuel orbit transfer path by optimizing the thrust direction and duration. The formulation, known as the Mayer problem in the calculus of variations, yields a two point boundary value problem. A Newton-Raphson method was used to attempt convergence of this two point boundary value problem, but it was found to be inadequate. However, with the final orbit unspecified numerous solutions satisfying the Mayer formulation were generated and then compared with the optimum two-impulse transfer between the same two orbits. This comparison is quite revealing; it shows first, that for the restricted class of orbits examined the optimum two-impulse estimate of velocity increment, or fuel required is very good. Second, it demonstrates that although the optimum departure and arrival points obtained from the impulsive and finite thrust solutions may be quite different, the penalty in using the former for design estimates may be quite minor. Author

N66-20180# Princeton Univ., N. J. Dept. of Physics.
EXPERIMENTAL AND THEORETICAL INVESTIGATION OF GRAVITATION Annual Summary Report
R. H. Dicke 31 Dec. 1965 9 p refs
(Contract Nonr-1858(30))
(AD-626735) CFSTI: HC $1.00/MF $0.50

Research into the theory of gravitation is summarized. Abstracts are given of the following reports: Theory of the formation of galaxies: Helium production in the big bang: Background radiation from young galaxies: Measurements on cosmic blackbody radiation. TAB

N66-20578# Army Foreign Science and Technology Center, Washington, D. C.
EQUALIZATION OF COSMIC SPATIAL TRIANGULATION IN A SYSTEM OF RECTANGULAR GEOCENTRIC COORDINATES
B. M. Klenitskiy and G. A. Ustinov Dec. 1965 21 p refs Transl. into ENGLISH from Geodez. i Kartograf (Moscow), no. 5, May 1964 p 3–16
(FSTC-381-T65-676; AD-627015) CFSTI: HC $1.00/MF $0.50

Methods are given for the calculation of the observation station coordinates with one and with two reference stations, based on geodetic satellite observational data. The equalization of the celestial triangulation is discussed, using the method of direct measurements and the method of closing directions. Equations are derived for the triangulation solutions and error determination, and the effects of systemic errors in measurement on the equalization of the celestial triangulation are discussed. E.A.O.

N66-20584# Lockheed-California Co., Burbank.
SELENODETIC MEASUREMENTS AND ERROR ANALYSES OF TWO LOCKHEED ANNULAR ECLIPSE EXPEDITIONS TO AFRICA Final Report, 1 Jun. 1964–31 May 1965
Laurence G. Stoddard, Donald G. Carson, and John S. Fritzen Jan. 1966 107 p refs
(Contract AF 19(628)-4162)
(LR-18858; AFCRL-65-532; AD-627064) CFSTI: HC $4.00/MF $0.75

The methods used to obtain and analyze the results of two annular eclipses in Africa by Lockheed USAF expeditions are described. Comparison is made with University of Manchester results and Watts Atlas of the Marginal Zone of the moon. The 1962 July 31 eclipse agrees well with Watts for local irregularities but does contain a discrepancy. The 1963 January 25 shows good correlation with the same discrepancy. A description of the expeditions and recommendations for future work is also made in this report. Author (TAB)

N66-20640# Naval Observatory, Washington, D. C.
RECTANGULAR COORDINATES OF MERCURY 1800-2000
R. L. Duncombe, Z. Tufekcioglu, and G. Larson 2 Apr. 1965 218 p *Its* Circular no. 106
(AD-625910) CFSTI: HC $6.00/MF $1.25

The rectangular heliocentric equatorial coordinates in this circular are intended chiefly for use in the numerical integration of orbits of celestial bodies, natural or artificial, which approach closely to Mercury. They are referred to the mean equinox and equator of 1950.0. They have been calculated from Newcomb's general theory of the motion of Mercury (Astronomical Papers prepared for the use of the American Ephemeris and Nautical Almanac, volume VI, 1898), and are tabulated for every second day from J. D. 237 8492.5 to J. D. 245 2048.5. Author (TAB)

N66-20641# Texas Univ., Austin. Dept. of Astronomy.
SPECTROSCOPIC AND RADIAL VELOCITY SURVEY OF BRIGHT GALAXIES Final Report, 1 Mar. 1961–30 Nov. 1965
Gerard de Vaucouleurs and Antoinette de Vaucouleurs 15 Dec. 1965 7 p
(Contract Nonr-375(13))
(AD-625400) CFSTI: HC $1.00/MF $0.50

Program objectives for systematic survey of galaxy red shifts are listed, and statistics given on the observations made with the spectrograph, Cassegrain camera, and photo-

electric scanner. Galaxies of various morphological and spectral types were scanned for red shift determination mostly in the blue region from λ3700 to λ5300 with spectral resolutions of 10 Å to 20 Å. Preliminary reductions indicate that red shifts may be determined with an error of about 1 Å for absorption lines, and 0.5 Å for emission lines. In addition, the scans are used to derive equivalent widths of absorption lines. Measurement and reduction information is also reported, and a list of research publications is included. M.G.J.

N66-20648# Royal Greenwich Observatory, Herstmonceux (England).
TIME AND LATITUDE SERVICE, JANUARY–MARCH 1965
R. J. D. R. Woolley London, HMSO, 1966 29 p refs *Its* Bull., No. 105; Joint Publ. with Roy. Obs., Cape of Good Hope HMSO: 3s 6d

Daily time and latitude values for U.T. are given, based on coordinated radio time signals and star positions. Brief descriptions of the earth's rotation rate, transatlantic comparisons in February 1965, Greenwich atomic time scale, and radio signal measurement and corrections are given. N.E.N.

N66-20663# Royal Aircraft Establishment, Farnborough (England).
THE INTERNATIONAL CONFERENCE ON THE PROBLEMS OF SATTELLITE OBSERVATION [TEMATYKA KONFERENCJI MIEDZYNARODOWEJ POSWIECONEJ PROBLEMOM BADAWCZYM ZWIAZANOM Z OBSERWACJAMI SZTRCZNYCH SATELITOW ZIEMI (MOSKWA-RYGA, 30 STYCZNIA-6 LUTEGO 1965 r.)]
Wojciech Pachelski Oct. 1965 13 p Conf. held in Moscow-Riga, 30 Jan.–6 Feb. 1965 Transl. into ENGLISH from RUSSIAN
(RAE-LIB-TRANS-1133) CFSTI: HC $1.00/MF $0.50

Activities of the satellite services in Czechoslovakia, Bulgaria, Hungary, U.S.S.R. are presented. Also included are abstracts of papers on simultaneous observations, photometric observations of artificial earth satellites, a method for determining the earth's gravitational potential, errors due to inaccurate ephemerides, and a method for processing observational data. N.E.N.

N66-20703# Aeronca Mfg. Corp., Baltimore, Md. Aerospace Div.
RESEARCH PROGRAM OF THE AERONCA ASTROMECHANICS INSTITUTE
[1965] 79 p refs

The Institute pursues selected branches of basic scientific research both as an end in itself and for promotion of the new concepts in astronautical technology which inevitably arise as a by-product. The mandate of the Institute is to make a sustained and coordinated attack upon the most difficult problems in mathematics and theoretical mechanics whose solution is relevant to the progress of astronautics. Current results and research projects have practical implications for: (1) theoretical astronomy and geophysics; (2) celestial ballistics; (3) space vehicle attitude dynamics; (4) design of either stable or optimal vehicle guidance and control systems; (5) aerodynamics and hydromagnetics (hence reentry and electrical propulsion); and (6) data acquisition and reduction. Author

N66-20805*# IIT Research Inst., Chicago, Ill.
ON A REFINEMENT OF THE THEORY OF THE MOON'S PHYSICAL LIBRATIONS
I. Michelson 1 Feb. 1966 23 p refs
(Grant NsG-561)
(NASA-CR-71148) CFSTI: HC $1.00/MF $0.50 CSCL 03C

The standard formulation of the dynamics of physical librations of the Moon is re-examined in the light of currently accepted reduced estimates of the mechanical ellipticity of the lunar equator. It is seen that a more complete mathematical model is required which accounts for centrifugal couples and in which the sum of inclinations of lunar orbit (5°9') and equator (1°3') is not regarded as an infinitesimal quantity. Although it remains doubtful whether linearized differential equations can be expected to yield a quantitatively useful theory, a preliminary to more accurate calculation consists in analyzing the motion with fewer restrictions than has been customary. The main features of such a treatment are given which unify the classical analysis by showing how the afore-mentioned inclinations can both be used to estimate the two principal mass parameters that affect physical librations. When accurate short-period libration data become available, the constants in question can be evaluated without recourse to orbital data used in the past. Author

N66-20846# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
A STUDY OF POSSIBLE INFRARED ASTRONOMY OBSERVATIONS OF BACKGROUND RADIATION FROM SPACE AND APPLICATION TO ROCKET AND PIGGYBACK OAO EXPERIMENTS
Walter Egan, Gerard C. Mc Coyd, S. Nevil Milford, Miriam Sidran, and Henry J. Stalzer, Jr. Apr. 1964 63 p refs
(RE-173)

A preliminary study has been made of possible experiments to measure the infrared astronomical background from balloons, rockets, and in an OAO piggyback experiment. Some attention has also been given to broad-band infrared photometry of nebulae, galaxies, and individual stars. The determining factors in the measurements are: the strong atmospheric infrared emission, and the need to chop infrared signals against a comparable reference level of radiation. Therefore, extended astronomical objects can be measured in the non-atmospheric window part of the spectrum only at very high altitudes in the earth's atmosphere. The conclusion is that infrared astronomical background measurements are extremely important and are technically feasible with existing vehicles and equipment. The preliminary study finds that, at the longer infrared wave lengths, rocket and OAO altitudes are necessary for the observation of the general background. Author

N66-20847# Geophysics Corp. of America, Bedford, Mass.
SOME ASTRONOMICAL AND GEOPHYSICAL CONSIDERATIONS FOR SPACE NAVIGATION
Ali M. Naqui and Richard J. Levy Mar. 1963 72 p refs
(GCA-634)

This paper deals with astronomical and geophysical considerations applicable to optical measurements made with self-contained equipment in a space vehicle in order to determine its position and/or velocity. Various measurements made from the earth, their temporal variations, and their accuracy, as applied to space navigation are discussed. Information regarding stellar positions, magnitudes, spectra, and frequency distribution is presented. A discussion of planetary positional ephemerides, diameters, phase curves, albedos and spectral characteristics is given. The advantages and disadvantages of using asteroids vis-a-vis planets are discussed. These are several problems in observing terrestrial occultations of stars from a satellite due to the presence of the earth's atmosphere.

Pertinent atmospheric characteristics, such as cloudiness, absorption, scattering and emission of radiation are discussed in the above context. Author

N66-20881 Michigan Univ., Ann Arbor. Dept. of Instrumentation Engineering.
MINIMUM FUEL ANALYSIS OF A LUNAR SOFT LANDING MISSION USING FEEDBACK CONTROL
John R. Hoffman Jun. 1965 23 p refs
(Contract AF 33(608)-086)
(AD-624681) CFSTI: HC $1.00/MF $0.50

The problem of making a soft landing on the moon's surface with a vehicle using conventional chemical rocket engines with restart capability was studied in this paper. In particular, a minimum fuel control scheme utilizing readily computed controls has been sought and found. By studying the problem from a constant gravity viewpoint, it was found that by running several external trajectories backwards from the moon's surface, some very interesting similarities in the trajectories were noticed. When the thrusting angle was plotted against velocity direction for the various extremal trajectories, these curves fell very close together for the low thrust case, and fell on the same curve for medium and high thrust cases (see charts). The results of this paper show that a very simple feedback control exists which is for all practical purposes optimal. The trajectory has a thrust profile which is full on, or off in a coasting phase, depending on the initial conditions and the landing point desired. TAB

N66-20904*# General Dynamics, Fort Worth, Tex.
A STUDY OF JUPITER FLYBY MISSIONS Mid-Term Technical Report
17 Feb. 1966 372 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951285)
(NASA-CR-71294; FZM-4572) CFSTI: HC $7.00/MF $2.00
CSCL 22A

Definitions and descriptions of scientific experiments appropriate for Jupiter flyby missions have been completed. The investigations of the characteristics of Earth-Jupiter transfer trajectories during the time period 1973-1980 and the evaluation of the five launch vehicles of interest for Jupiter missions are completed. Analyses and designs in the areas of communications, data management, navigation and guidance, spacecraft control, midcourse propulsion, attitude control, and power are essentially complete. Design perturbations in the above areas are expected during the last half of this study from the studies now beginning of thermal control, radiation protection, meteoroid protection, spacecraft structure, and reliability. Spacecraft subsystem integration and configuration designs have been accomplished on the basis of the work completed. Four spacecraft design concepts have been evolved during the first half of the study. Concept A is spin-stabilized, adaptable only to a limited number of scientific instruments. In terms of mass, it is the smallest of the four concepts. Spacecraft design Concepts B, C, and D all embody a design philosophy of 3-axis stabilization, but differ in scientific capability, subsystem complexity, and total mass. Author

N66-20931*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE USE OF SHORT ARCS IN ORBIT DETERMINATION
Hans G. Hertz Washington, NASA, Mar. 1966 113 p refs
(NASA-TN-D-3172) CFSTI: HC $1.30/MF $0.75 CSCL 22C

At the IAF Congress in Stockholm in 1960, it was urged that osculating elements of satellite orbits be determined for individual station passages. This implied determinations from short arcs. The present investigation shows that, with the exception of the semi-major axis, the elements of the orbit of Echo I can indeed be determined from arcs with a half-arc length of $1^h.4$ to 4^h to the same accuracy as from conventional 1-day arcs. Several such determinations over an interval as short as 30 hours reveal deviations from gravitational behavior. Using 1-day arcs, such deviations can be readily found only from determinations spanning a longer interval. Author

N66-21006*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EGO ORBITAL PARAMETERS AND HEAT INPUTS
H. E. Montgomery and S. J. Paddack 1 Apr. 1963 79 p refs
(NASA-TM-X-55428; X-643-63-61) CFSTI: HC $3.00/MF $0.75 CSCL 22A

Methods of analysis for computing orbital, spacecraft angle, and spacecraft heat input data for OGO (Orbiting Geophysical Observatory) are presented. Specific results are given for the S-49, Eccentric Orbiting Geophysical Observatory (EGO). The orbital data include the transient behavior of true anomaly, the flight path angle, the distance from the center of the earth to the satellite, the angle between the line of apsides and the ecliptic plane, and the angle between the projection of the line of apsides on the ecliptic plane and the earth-sun line. The spacecraft angle data include the transient behavior of solar array angle, the orbital plane experiment package (OPEP) angle and the OPEP velocity vector angle. The transient heat input data include earth emitted heat, direct solar heat, and earth reflected solar heat inputs to all the faces of the main OGO box, the solar array, and the OPEP. The calculated results are consistent with the previously conducted EGO Launch Window Study insofar as the perigee restraint is concerned. The present data are for launch times for which the perigee will not go below its initial value for a whole year. L.S.

N66-21033*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANGLE-OF-ATTACK ANALYSIS FOR PROJECT FIRE 1 PAYLOAD REENTRY FLIGHT
Gerard E. Woodbury Washington, NASA, Apr. 1966 58 p refs
(NASA-TN-3366) CFSTI: HC $0.85/MF $0.50 CSCL 22C

An investigation of the flight motions of the Project Fire 1 payload was made through the use of digital-computer simulation techniques since limited motion instrument data did not permit more direct methods of analysis. The simulations were obtained from a six-degree-of-freedom computer program which numerically solved the equations of motion. The complete nonlinear wind-tunnel data and calculated time histories of the mass characteristics of the body were used in the program. This investigation was to determine the angle-of-attack and motion histories of the reentry package during the heating data period of the Project Fire 1 experiment. The reentry package experienced a distrubance at about 1666 seconds of elapsed flight time at an altitude of approximately 69,800 meters and a velocity of about 11,500 meters per sec. Prior to the disturbance, the body was coning with a half-angle OF about 1°. The results of the analysis indicated that the angle-of-attack envelope increased to about 33° after the disturbance. The factors which caused the disturbance could not be isolated. The angle-of-attack envelope damped from 33° to about 13° at maximum dynamic pressure. The roll rate was initially 18.85 radians/sec. The motion patterns of the body were typical of those for bodies which are statically stable and have roll-to-pitch inertia ratios greater than 1. The simulations indicated that trim was small. Author

N66-21045*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SPACE FLIGHT HANDBOOKS. VOLUME III: PLANETARY FLIGHT HANDBOOK. PART 5: TRAJECTORIES TO JUPITER, CERES, AND VESTA
Stanley Ross, ed. Washington, NASA, 1966 541 p refs Prepared for JPL
(Contract JPL-950871)
(NASA-SP-35, Pt.-5) GPO: HC $3.00; CFSTI: MF $2.75 CSCL 22C

A series of charts and tables of trajectory data associated with one way trips from Earth to Jupiter and to the asteroids Ceres and Vesta for the time period 1970–1980 are presented. Included are, hyperbolic excess speed contour charts, tabular trajectory data from which the contour charts were prepared, and planetary position and velocity data for the years 1960–2000. A brief explanation of the data and the procedures for using the handbook are included. H.S.W.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N66-19827# Radio Corp. of America, Camden, N. J. Defense Electronic Products.
SPACE ELECTRONICS
[1965] 78 p refs

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3. GEMINI SPACECRAFT PCM-FM TELEMETRY TRANSMITTERS R. G. Erdmann p 14–15 ref (See N66-19830 10-07)

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N66-19839 Radio Corp. of America, Princeton, N. J. Astro Electronics Div.
EFFECT OF SYSTEM CONSTRAINTS ON MECHANICAL DESIGN OF SPACECRAFT
L. Berko and W. Cable *In its* Space Electron. [1965] p 54–57 (See N66-19827 10-31)

Basic theories and design concepts of advanced spacecraft do not differ drastically from that of standard aircraft. However, the stringent environmental, launch, packaging, and subsystem mission parameters of present satellite design require a larger scope of knowledge and a more refined application of these basic engineering principles. Spacecraft design requires the efficient integration of the numerous components necessary to perform the specified mission requirements. One important aspect of overall satellite design is the structure; just how this structure is designed, and effects of the system constraints upon design are considered herein. Author

N66-19840 Radio Corp. of America, Princeton, N. J. Mechanical Analysis Group.
ANALYTICAL APPROACHES TO THE STRUCTURAL DESIGN OF SPACECRAFT
Robert Goldberg *In its* Space Electron. [1965] p 58–60 (See N66-19827 10-31)

In the mechanical design of spacecraft, theoretical analysis is used to: (1) verify the ability to achieve the design objectives (usually in relation to the launch and space environments), and (2) optimize the verified design in relation to weight, volume, and strength. Specific analyses include methods for determining the layout of equipment on a spin-stabilized satellite, and a method for performing the stress analysis of a typical built-up sheet-metal structure, such as the baseplate of a TIROS satellite. Author

N66-19998# Lockheed-California Co., Burbank. Technical Information Center.
SPACE PROGRAMS 1962–1985
E. E. Whitney Mar. 1966 48 p
(SP-66-1)

The current and proposed space programs through 1985 are listed. The boosters used for each launch, project designation, booster dimensions and launch dates are given. A brief description of each project is included. H.S.W.

N66-20073*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE AEROELASTIC CHARACTERISTICS OF THE SATURN-IB SA-201 LAUNCH VEHICLE
Dennis M. Jecmen Aug. 1965 32 p refs
(Contract NAS8-11238)
(NASA-CR-71024; M-37-65-2) CFSTI: HC $2.00/MF $0.50 CSCL 22D

The flow environment surrounding the Saturn IB SA-201 vehicle is dominated by regions of separated flow in the transonic Mach number range. The highly non-linear loadings resulting from flow separation coupled with the modal deflections of a long flexible vehicle as the SA-201 have a dominant influence upon vehicle dynamics. A quasi-steady method requiring an experimental static load distribution as input has been used in analysis of the SA-201 vehicle to obtain the aerodynamic damping for the first three bending modes. The analytical results indicate that the SA-201 vehicle is aerodynamically damped over the critical Mach number range ($0.8 \leq M \leq 2.0$) and therefore is expected to be damped over the entire ascent Mach number range. Author

N66-20662# Centre National d'Etudes Spatiales, Paris (France). Division Information et Documentation.
THE D-1 SATELLITE [LE SATELLITE D-1]
Feb. 1966 65 p refs In FRENCH CFSTI: HC $3.00/MF $0.75

The French geodetic satellite D-1 is described. Details are given on: (1) structure, stabilization and equilibrium, electronic equipment, and control devices; (2) fabrication and tests; (3) power supply; (4) telemetry and command devices; (5) the scientific program; (6) launching and operating plans; (7) measurement apparatuses; and (8) data processing operations. Also included are drawings and schematics illustrating the satellite, its telemetry system, and the launch vehicle, along with a chart showing the planned orbit and the location of tracking and receiving stations. Transl. by D.T.

N66-20896*# Chrysler Corp., New Orleans, La. Space Div.
SATURN S-IB STAGE ASSEMBLY AND TEST REPORT, S-IB-1
George M. Quin and Earl M. Wilson 9 Aug. 1965 186 p refs
(Contract NAS8-4016)
(NASA-CR-71166; RB-B1-EIR-5.1) CFSTI: HC $5.00/MF $1.25 CSCL 22D

The object of this report is to provide interested personnel with an overall summary of the events and problems encountered during the manufacture of Saturn Stage S-IB-1. The report covers the stage from the start of subassembly installation (clustering) on 18 June 1964 until release of the stage for shipment to Kennedy Space Center, Florida, on 9 August 1965. Author

N66-20909*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 6, NUMBER 2
31 Jan. 1966 26 p
(NASA-TM-X-56876; X-537-65-217) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Tabulations on orbiting objects are presented, based on data computed and compiled by the Goddard Space Flight Center, NORAD, and the Smithsonian Astrophysical Observatory, as of 1200Z on January 31, 1966. Information includes the code name, catalog number, source, launch, period minutes, inclination, apogee, perigee, and transmitting frequency. A list of decayed objects is also included, with the code name, catalog, source, launch, and decay dates given. M.G.J.

N66-20929*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT DEMONSTRATION OF A NOSE-MOUNTED ROTATING-SOLID-PROPELLANT ROCKET CONTROL SYSTEM AND A COMPARISON WITH ANALOG STUDIES
Kirby H. Williams and Robert L. James, Jr. Washington, NASA, Mar. 1966 43 p refs
(NASA-TN-D-3335) CFSTI: HC $2.00/MF $0.50 CSCL 22B

A flight test investigation of a space vehicle upper stage employing a rotating solid rocket attitude control system is described. Experimental data received from an onboard telemetry system are presented and discussed. These data show that the control system is capable of providing three-axis control of the space vehicle upper stage in the flight environment. Postflight analog computer studies are also presented and compared with the flight data. These results show good agreement, and thus validate the mathematical representation of the flight system. Author

N66-20930*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TECHNIQUE FOR REMOVAL OF ANGULAR MOMENTUM FROM A SPACECRAFT MOMENTUM-EXCHANGE SYSTEM BY USE OF THE GRAVITY-GRADIENT MOMENTS
David B. Middleton Washington, NASA, Mar. 1966 33 p refs
(NASA-TN-D-3309) CFSTI: HC $0.40/MF $0.50 CSCL 22B

An analytical study has been made of attitude control of manned orbiting spacecraft by means of planned momentum exchange between the spacecraft and a system of spinning wheels aboard the spacecraft. This technique allows the spacecraft to maintain a fixed attitude with respect to some quasi-inertial reference during part of each orbit and then to dissipate the bias portion of the accumulated angular momentum during the remainder of the orbit. The momentum dissipation is accomplished by reorienting the spacecraft in the earth's gravity field in such a way that the unidirectional component of the disturbance torque will be reversed whereas the sinusoidal components will retain their cyclic nature. No attitude jet fuel is required for either the reorientation maneuver or for the momentum dissipation. It was found that a useful and adequate attitude orientation can be achieved with a roll-only maneuver during most of the year. The multi-axis maneuvers provide a relatively large momentum-dissipation capability and much greater operating flexibility. The attitude-management tasks seem to be well suited to manual control. The attitude maneuvers need not be performed in a highly precise manner because small errors in the timing and execution of particular maneuvers can be compensated for during succeeding orbits by the simple process of monitoring and iterative correction. Author

N66-20937*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTEGRATING SPACECRAFT SYSTEMS
Allen L. Franta Washington, NASA, Apr. 1966 23 p refs
(NASA-TN-D-3049) CFSTI: HC $0.30/MF $0.50 CSCL 22B

The integration of a satellite or spacecraft system consists of combining the mechanical and electrical subsystem elements into a single entity through the application of logical processes, and takes into account the physical and functional aspects of the subsystem interrelationships. It is characterized by three levels of effort: (a) project management integration, (b) integration of physical systems, and (c) integration by subsystem combination through advanced design. The overall coordination of a spacecraft project is a

responsibility of a project management group assigned the task of translating functional concepts into an operating spacecraft. The actual physical integration of a spacecraft system is accomplished through the combined work of a mechanical integration group and an electronic integration group working together in a concerted effort. Subsystem combination through advanced electronic design is a more sophisticated form of partial spacecraft integration. Author

N66-20987*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASA SOUNDING ROCKET PROGRAM: SUMMARY OF SOUNDING ROCKET FLIGHTS
J. A. Sterhardt Nov. 1965 399 p refs
(NASA-TM-X-55429; X-721-65-456) CFSTI: HC $7.00/MF $2.00 CSCL 16D

Data are presented on sound rocket flights conducted under the NASA sounding rocket program. This includes information on the rockets, the ground and rocketborne equipment employed, rocket and equipment performance, and the experiments undertaken. C.T.C.

N66-21031*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPUTER ANALYSIS OF INTERPLANETARY MONITORING PLATFORM (IMP) SPACECRAFT PERFORMANCE
Frank Piazza Washington, NASA, Mar. 1966 22 p
(NASA-TN-D-3340) CFSTI: HC $0.30/MF $0.50 CSCL 22B

The significant features of this method of approach are described in detail, and their successful application to the prelaunch phase of the IMP spacecraft and of the scientific experiments assigned to the IMP missions are outlined. The effectiveness and advantages of this system are emphasized by the use of a compact general purpose computer to provide real-time telemetry data-processing for performance analysis. The analysis during prelaunch has been greatly improved by the system's flexibility, speed, and accuracy of operation compared with methods of analysis previously used. Also pointed out are the advantages of reduction in manpower needed for testing, and of mobility provided by housing the system in a van. The suitability of this system is evident for use with other types of spacecraft in the future, with minimal hardware modification. It is noted that more effective use of the present system depends on the development of more sophisticated software systems for relevant data-processing. Author

N66-21046*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. ORAL PRESENTATION: STUDY
11 Aug. 1965 40 p Prepared for JPL
(Contract NAS7-100; JPL-951113)
(NASA-CR-71472) CFSTI: HC $2.00/MF $0.50 CSCL 22B

An oral presentation for the Voyager spacecraft study is outlined. It includes various tables, graphs, diagrams, and general data on the spacecraft and subsystems design. R.N.A.

N66-21047*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME I: SUMMARY Study Report, Phase IA
30 Jul. 1965 107 p Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71468; TRW-5410-0001-RU-000) CFSTI: HC $4.00/MF $0.75 CSCL 22B

The results of the Phase IA Voyager spacecraft study are summarized. Included are a discussion of the approach used in arriving at an optimized spacecraft design, and a review of the individual tradeoffs and analyses completed during the optimization process, including the operational support equipment as well as the spacecraft. Conclusions concerning the benefits of a 1969 test flight and the design for that flight are summarized. Also included are major points developed in the course of drawing up an implementation plan which uses the 1969 test flight as a means of providing additional confidence in achieving a successful 1971 mission. R.N.A.

N66-21048*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME II: 1971 VOYAGER SPACECRAFT Study Report, Phase IA
30 Jul. 1965 492 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71469; TRW-5410-0002-RU-000) CFSTI: HC $7.92/MF $2.50 CSCL 22B

This volume presents the preferred design for the 1971 Voyager flight spacecraft and hardware subsystems. It provides overall ground rules, guidelines, and a definition of the general Voyager spacecraft system design philosophy; and discusses the primary system and mission requirements and the criteria for establishing an order of priority among competing factors. An explanation is given as to how the objectives and criteria will be met in terms of a breakdown into characteristics and restraints applicable to the spacecraft and its various functional elements. The preferred design and its operation at the spacecraft system level are described. Various system level areas requiring individual treatment are presented as separate functional descriptions. Functional descriptions are presented for each identified subsystem area. The design criteria and philosophies applicable to the individual subsystems are included along with technical descriptions covering subsystem functions. Functions performance and interactions with other subsystems are mentioned along with physical characteristics. R.N.A.

N66-21049*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME III: VOYAGER PROGRAM PLAN Study Report, Phase IA
30 Jul. 1965 764 p Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71470; TRW-5410-0003-RU-000) CFSTI: HC $10.64/MF $3.50 CSCL 22B

Results of the Voyager Phase IA study with respect to implementation of the spacecraft are presented. Included is a description of the effort required to design, develop, test, assemble, checkout, launch, and support spacecraft flight operations for both the 1969 and the 1971 mission. The plan primarily applies to the spacecraft, although the operational support equipment schedule interfaces of the system and its subsystems are also identified. The major milestone schedules for both Phase IB and II are presented along with discussions of schedule philosophy, critical areas, and schedule tradeoffs. The effects of the 1969 flight test program on the 1971 mission, overall test planning and control, and the generation of the Voyager integrated test plan are also discussed. A detailed description of engineering, test, spacecraft assembly, checkout, systems test, launch, and mission support operations during Phases IB and II to implement the 1969 flight test and 1971 mission is given. Manufacturing tasks are briefly treated in terms of schedule requirements and a preliminary estimate of the equipment to be delivered and the time needed for their manufacture. R.N.A.

N66-21050*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME IV: ALTERNATE DESIGNS, SYSTEMS CONSIDERATIONS Study Report, Phase IA

30 Jul. 1965 389 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71471; TRW-5410-0004-RU-000) CFSTI: HC $7.00/MF $2.00 CSCL 22B

This volume presents alternate designs generated and considered for the Voyager flight spacecraft. The extent to which the alternate spacecraft designs conform or take exception to the objectives and requirements as given in the preliminary Voyager 1971 mission specifications is reviewed. The major characteristics associated with the generated designs and the processes leading to the establishment of the major alternate classes of spacecraft design are described. The alternate system philosophies and associated spacecraft designs are presented. The designs are described with the aid of drawings, photographs, and summary and detailed tabulations of component parameters. Criteria are presented to reveal the basis for comparing the alternate designs and selecting the preferred spacecraft design. Analyses are included which serve to abstract from mission level requirements the performance requirements for the spacecraft, to evaluate the system performance of the alternate designs and to verify their meeting performance requirements, to assess spacecraft design reliability, and to compare competing design concepts and validate the selection of the preferred design.
R.N.A.

N66-21051*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME IV: ALTERNATE DESIGNS, SYSTEMS CONSIDERATIONS—APPENDICES Study Report, Phase IA
30 Jul. 1965 409 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71473; TRW-5410-0004-RU-001) CFSTI: HC $7.09/MF $2.00 CSCL 22B

An orderly procedure whereby spacecraft system alternates can be based upon the combined advantages of high velocity and low space craft weight is discussed. Reliability assessments for electrical equipment, the models and computations applied in the evaluation of redundancy options for electrical equipment, and mechanical equipment studies are presented, along with a list of the parts failure rates used in the reliability analyses. A justification based on mission specifications compatibility, is given for the selection of a limited number of integrated circuits. It is concluded that the use of selected integrated circuits in modern electronic hardware is consistent with the most advanced design techniques and with stringent requirements for a demonstrated history of reliability. The parameters for the nominal 1971 interplanetary trajectory and Mars orbit are given; the Doppler and Doppler rate limits for Voyager orbiter-to-earth communications are discussed; the celestial objects competing with the Canopus sensor are considered; and the approach guidance sensor is described.
D.T.

N66-21052*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME V: ALTERNATE DESIGNS, SUBSYSTEMS CONSIDERATIONS Study Report, Phase IA
30 Jul. 1965 814 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71474; TRW-5410-0005-RU-000) CFSTI: HC $11.19/MF $4.00 CSCL 22B

The selection of subsystems was based on the following general criteria: that the system or technique perform the required function; that the most simple and reliable method or approach be utilized; that the technique be consistent with the 1966 conceptual freeze date; and that the mechanization easily interface with other spacecraft functions. Each subsystem is described in terms of the approach for attaining increased reliability through the use of alternate modes and redundant components. Emphasis was placed on minimizing switching and control in achieving the alternate functions. Areas of discussion and description include: (1) the science payload and planet oriented package; (2) the telecommunications subsystem; (3) power and control subsystem design considerations; (4) mechanical subsystem tradeoffs; (5) electronics packaging and electrical distribution; and (6) the propulsion subsystem.
D.T.

N66-21054*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME V: ALTERNATE DESIGNS, SUBSYSTEMS CONSIDERATIONS, APPENDIX II Study Report, Phase IA
30 Jul. 1965 397 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71476; TRW-5410-0005-RU-002) CFSTI: HC $7.00/MF $2.00 CSCL 22B

The details of the analytic and tradeoff work in support of the design of the stabilization and control subsystems are assembled; and tradeoff studies in the gyro assembly, sun sensor, earth detector, and star sensor are presented. Also presented are an analysis of the major disturbance torques, and the analyses underlying the choices in the preferred subsystem design. Investigations concerning the communications and data handling problems of the Voyager spacecraft are reported. These cover: (1) range and rate, capsule link, telemetry link and telemetry synchronization and acquisition analyses; (2) pseudo-noise synchronizer performance; and (3) threshold criteria for phaselock receiver. The solar cell tradeoff analysis is discussed, along with the solar array mechanical and thermal designs. Studies are reported on the bipropellant and monopropellant feed system configurations; the preliminary calculations for lander cover base separation springs are given; and an infrared radiometric model of Mars is included.
D.T.

N66-21056*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME VII: 1969 FLIGHT TEST SPACECRAFT AND OSE Study Report, Phase IA
30 Jul. 1965 123 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71478; TRW-5410-0007-RU-000) CFSTI: HC $4.00/MF $1.00 CSCL 22B

This volume serves to consolidate the presentation of Voyager spacecraft and operational support equipment design as well as program planning for a 1969 flight test mission. Because of the design similarity of the 1969 and 1971 systems, basic descriptive data is only summarized. Included are both flight test spacecraft and operational support equipment mission objectives, design criteria, system and subsystem descriptions, and implementation plans.
R.N.A.

N66-21057*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME I: PREFERRED DESIGN.: SYSTEM CONSIDERATIONS Final Technical Report, Phase IA, Task B
17 Jan. 1966 337 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71483; TRW-5410-6001-R0-V01) CFSTI: HC $7.00/MF $1.75 CSCL 22B

This volume presents the preferred design for the Voyager flight spacecraft. Included are the applicable mission objectives and design criteria for the selected design, the applicable spacecraft design characteristics and restraints,

and a system level functional description of the flight spacecraft. Several appendices are also included to present supporting system analyses developed during the study. R.N.A.

N66-21058*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME II: PREFERRED DESIGN: SUBSYSTEMS Final Technical Report, Phase IA, Task B
17 Jan. 1966 479 p Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71482; TRW-5410-6001-R0-V02) CFSTI: HC $7.79/MF $2.25 CSCL 22B

This volume presents the preferred design for all Voyager spacecraft subsystems. It also describes the planetary vehicle adapter and indicates interface requirements assumed for the spacecraft science payload. Included are the designs for the spacecraft bus subsystems, propulsion subsystem, science subsystem, and planetary vehicle adapter. A general description, requirements and constraints, functional interfaces, design description, and parameters and performance summary are presented for each subsystem. Whenever pertinent, design alternatives and growth potential for the subsystem are also discussed. R.N.A.

N66-21059*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME III: SPACECRAFT IMPLEMENTATION Final Technical Report, Phase IA, TASK B
17 Jan. 1966 429 p Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71481; TRW-5410-6001-R0-V03) CFSTI: HC $7.29/MF $2.25 CSCL 22B

This volume presents the results of the Phase IA, Task B, study for implementation of the Voyager spacecraft. It describes the effort required to design, develop, test, assemble, checkout, launch, and support spacecraft flight operations for the 1971 mission. The plan applies to the spacecraft system only, although the operational support equipment schedule interfaces are also identified. The major milestone schedules for both Phase IB and II are presented along with discussions of the schedule philosophy, overall test planning, and generation of the Voyager integrated test plan. Tasks necessary to meet the launch date are identified and scheduled. Manufacturing tasks are briefly treated in terms of schedule requirements and equipment deliveries. The appendices include additional information on plans for assembly, test, and launch operations; alignment; magnetic properties control; contamination control; electromagnetic compatability control; material acquisition; and material handling and packaging. R.N.A.

N66-21061*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME V: TRADEOFF ANALYSES Final Technical Report, Phase IA, Task B
17 Jan. 1966 222 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71479; TRW-5410-6001-R0-V05) CFSTI: HC $6.00/MF $1.25 CSCL 22B

This volume describes tradeoff studies performed to provide the basis for the propulsion system selection for Voyager Task B. The propulsion systems considered were a solid propellant retro-motor based on a modified Minuteman Wing VI stage 2 motor, a modified Titan III-C transtage system, a modified LEM descent stage motor, and a custom liquid propulsion system using the LEM descent stage engine and an optimized propellant feed system. These systems were compared for success probability, performance, cost, flexibility, effect on spacecraft design, and hazard to planetary quarantine. Results indicate that the modified LEM descent stage propulsion system is the best choice. R.N.A.

N66-21062*# Boeing Co., Seattle, Wash.
VOYAGER—ORAL PRESENTATION
Aug. 1965 158 p Presented to JPL, Pasadena, Calif., 9 Aug. 1965
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71501; D2-82732-1) CFSTI: HC $5.00/MF $1.00 CSCL 22B

The technical problems which were encountered in developing the Voyager spacecraft preliminary design are reviewed. Those areas discussed are: planetary quarantine, Mars orbit selection, propulsion performance, reaction control reliability, antenna stabilization and pointing, recorder selections, and telecommunications reliability. Each area is examined in detail and design concepts are presented. H.S.W.

N66-21063*# Boeing Co., Seattle, Wash.
VOYAGER SPACECRAFT SYSTEM. MANAGEMENT PHILOSOPHY AND PROGRAM HIGHLIGHTS Final Technical Report
Jul. 1965 94 p Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71502; D2-82709-0) CFSTI: HC $3.00/MF $0.75 CSCL 22B

The design concepts, management philosophy and program highlights of the research toward the Voyager spacecraft development are summarized. An illustration of the preferred flight spacecraft is shown and the sequence of preliminary design events which lead to this concept is discussed. The spacecraft subsystems are reviewed and recommendations for the 1969 and 1971 space flights are given. H.S.W.

N66-21064*# Boeing Co., Seattle, Wash.
VOYAGER SPACECRAFT SYSTEM. VOLUME A: PREFERRED DESIGN FOR FLIGHT SPACECRAFT AND HARDWARE SUBSYSTEMS, PART I Final Technical Report
Jul. 1965 476 p Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71503; D2-82709-1) CFSTI: HC $7.76/MF $2.25 CSCL 22B

The mission objectives and design criteria for the proposed 1971 Voyager mission are reviewed. Design values for the Mars magnetically trapped radiation and the Mars meteoroid environment were selected, recognizing the upper limit for the radiation and worst case for the meteoroid environments. Justifications for the selected design values are given. The system aspects of the Voyager spacecraft are also discussed. Trajectory choices are examined in terms of mission versatility subject to constraints on planetary contamination and on desired photographic data. Design parameters for components of the flight spacecraft are discussed, and requirements on the interfaces between various items of flight equipment and the launch vehicle are described. Telemetry criteria are examined and a list of the flight equipment telemetry channels required is provided. The various features of the spacecraft layout, configuration, and flight equipment are presented including, spacecraft reference axes, mechanical alignment provisions, general arrangement of the exterior, and provisions for equipment mounting. H.S.W.

N66-21065*# Boeing Co., Seattle, Wash.
VOYAGER SPACECRAFT SYSTEM. VOLUME A: PREFERRED DESIGN FOR FLIGHT SPACECRAFT AND HARDWARE SUBSYSTEMS, PART II Final Technical Report
Jul. 1965 1100 p Prepared for JPL
(Contract NAS7-100; JPL-951111)
(NASA-CR-71504; D2-82709-1) CFSTI: HC $14.00/MF $5.00 CSCL 22B

The subsystems incorporated in the preferred design of the Voyager spacecraft are described. Telecommunications and electrical power subsystems are reviewed including considerations of solar panel structure as well as electrical characteristics of the panels, batteries, and power conditioning equipment. A discussion of the spacecraft propulsion subsystem covers engines for midcourse correction, orbit insertion and orbit trim. Weight, center of gravity location, and moments and products of inertia are also considered. The general characteristics of a typical spacecraft science subsystem are summarized, the attitude and autopilot subsystems are described, and the central computer and sequencer are evaluated. H.S.W.

N66-21066*# Boeing Co., Seattle, Wash. Aero-Space Div.
VOYAGER SPACECRAFT SYSTEM. VOLUME A: PREFERRED DESIGN FOR FLIGHT SPACECRAFT AND HARDWARE SUBSYSTEMS, PART III
Jul. 1965 428 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71505; D2-82709-1) CFSTI: HC $7.28/MF $2.25 CSCL 22B

Schedules and implementation plans are presented for the preferred design of the spacecraft and operational support equipment. The following three master schedules are discussed: (1) the accomplishment of a 1971 mission without a prior test flight; (2) the accomplishment of a 1971 mission preceded by a test flight in 1969 using Atlas/Centaur; and (3) the accomplishment of a 1971 mission preceded by a test flight in 1969 using Saturn IB/Centaur. It is indicated that these schedules are sufficiently flexible to accommodate, without significant impact, any combination of the features of the alternate spacecraft designs. Also presented are a system reliability summary and integrated test plan development. R.R.D.

N66-21067*# Boeing Co., Seattle, Wash. Aero-Space Div.
VOYAGER SPACECRAFT SYSTEM. VOLUME B: ALTERNATE DESIGNS CONSIDERED FOR FLIGHT SPACECRAFT AND HARDWARE SUBSYSTEMS Final Technical Report
Jul. 1965 806 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71506; D2-82709-2) CFSTI: HC $11.06/MF $4.00 CSCL 22B

Alternate mission objectives, design characteristics, and system and subsystem designs for the Voyager Spacecraft System are presented, as well as the bases on which a preferred system is selected. The choice of a preferred method or technique is based heavily on mission success considerations (reliability), state-of-development of equipment, weight, safety, and versatility (applicability to various missions). It is pointed out that alternate missions for the spacecraft were considered in terms of reduced objectives which might be attained despite occurrence of certain critical, but not totally disabling, malfunctions of the spacecraft. These considerations indicate that substantial value could be derived from a mission despite such malfunctions. R.R.D.

N66-21069*# Boeing Co., Seattle, Wash. Aero-Space Div.
VOYAGER SPACECRAFT SYSTEM. VOLUME D: DESIGN FOR 1969 TEST SPACECRAFT Final Technical Report
Jul. 1965 215 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71508; D2-82709-4) CFSTI: HC $6.00/MF $1.25 CSCL 22B

Consideration was given to several 1969 test flight options and spacecraft configurations and to two launch vehicles. It is indicated that the recommended 1969 test flight program has the advantages of providing direct support to and enhancement of the 1971 Voyager program and of providing flexibility of implementation through multiple launch date and launch vehicle choices. The objective of the 1969 test flight is to enhance the probability that the 1961 mission will be successful. In evaluating the potential ways of achieving this objective and the value of any 1969 test flight, the following are recommended: (1) A 1969 test flight can be accomplished within a properly phased 1971 Voyager program. (2) The 1969 launch vehicle should be a Saturn IB/Centaur. (3) If the Saturn IB/Centaur cannot be made available, a 1969 Mars flyby using an Atlas/Centaur launch vehicle and a 1971 spacecraft bus with minimum modification is recommended. (4) If the Mars orbit launch period is missed, the Saturn IB/Centaur-launched test spacecraft should be placed on a Mars flyby trajectory; and if this opportunity is also missed, the test spacecraft should be placed on an heliocentric orbit simulating a Mars flyby. R.R.D.

N66-21071*# Boeing Co., Seattle, Wash. Space Div.
VOYAGER SPACECRAFT SYSTEM. MANAGEMENT AND TECHNICAL HIGHLIGHTS Final Technical Report, Task B
Jan. 1966 113 p Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71514) CFSTI: HC $4.00/MF $0.75 CSCL 22A

Management tasks associated with the preparation and implementation of spacecraft system design, development, launch, and mission support activities for the Voyager project are discussed. The technical highlights of the preferred design are reviewed. They include: (1) preferred flight spacecraft configuration; (2) subsystem design; (3) mission versatility; (4) planetary quarantine; and (5) operational support equipment. Also considered are the construction of new test facilities and expanded Voyager missions to other planets. R.R.D.

N66-21072*# Boeing Co., Seattle, Wash. Space Div.
VOYAGER SPACECRAFT SYSTEM. VOLUME A: PREFERRED DESIGN FOR FLIGHT SPACECRAFT AND HARDWARE SUBSYSTEMS, PART I Final Technical Report, Task B
Jan. 1966 360 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71513; D2-82709-6) CFSTI: HC $7.00/MF $1.75 CSCL 22B

The primary objective of the Voyager program, which is reviewed in detail, is the scientific investigation of the solar system by means of instrumented, unmanned spacecraft that will fly, orbit, and land on the planets. As a result, scientific information about the origin, evolution, and nature of life will be acquired and applied toward an understanding of terrestrial life. The 1971 mission is first in the logical development of the sequenced missions for achieving Voyager Mars objectives which are to place a science payload in orbit about Mars, conduct observations of Martian phenomena with this payload over extended periods of time, and transmit the data to Earth. Other objectives are to enter the Martian atmosphere

and land on the Martian surface, and conduct observations relating to critical Mars landing design parameters in orbit and in the atmosphere as required. Also discussed are: (1) the design characteristics of the flight spacecraft and the guidance and navigation requirements and restraints; (2) the planetary quarantine requirements; and (3) the system-level functional description of the preferred spacecraft design and its relationship and interfaces with other mission elements.
R.R.D.

N66-21073*# Boeing Co., Seattle, Wash. Space Div.
VOYAGER SPACECRAFT SYSTEM. VOLUME A: PREFERRED DESIGN FOR FLIGHT SPACECRAFT AND HARDWARE SUBSYSTEMS, PART II Final Technical Report, Task B
Jan. 1966 818 p Prepared for JPL
(Contracts NAS7-100; JPL-951111)
(NASA-CR-71512; D2-82709-6) CFSTI: HC $11.18/MF $4.00 CSCL 22B

The hardware subsystems selected for the flight spacecraft are described, as well as the main criteria leading to the selection of the following subsystem designs: (1) the probability of success; (2) the performance of mission objectives; (3) cost savings; (4) contributions to subsequent missions; and (5) additional 1971 mission capability. To achieve these objectives, the main subsystem design guidelines are: simple and conservative design based on Mariner and Ranger technology and experience, design reliability through inherent and selected redundancy, rigorous interface control, and an integrated test program of component, subsystem, and system testing. A pictorial description of the major interfaces among the spacecraft system elements, subsystems, and other parts of the Voyager system is presented. Functions to be performed by the spacecraft subsystems during each mission phase are defined in the mission sequence matrix.
R.R.D.

N66-21076*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PHASE 1A, TASK B: ORAL PRESENTATION
7 Feb. 1966 194 p Prpeared for JPL
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71484) CFSTI: HC $5.00/MF $1.25 CSCL 22B

An outline of Phase 1A technology for the Voyager spacecraft system, including charts, tables, block diagrams, schematic diagrams, and data, are presented. Areas covered include the project management structure, propulsion and configuration selection, trajectory and orbit selection, automatic features, operational support equipment, and problems of planetary quarantine. Other problem areas such as planetary vehicle separation, array-battery load sharing, antenna deployment/articulation, attitude control jets, approach guidance, and attitude verification are also outlined. Some of the diagrams presented are the spacecraft envelope; propulsion location; antenna, PSP, propulsion, and electronics location; solar panel configuration; current LEMDE propulsion unit configuration and modifications; and the current transtage. The spacecraft telecommunications systems are also outlined.
L.S.

N66-21077*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PRELIMINARY DESIGN, VOLUME A (BOOK 1 OF 4): FLIGHT SPACECRAFT PREFERRED DESIGN—SYSTEM DESCRIPTION
30 Jul. 1965 388 p refs Prepared for JPL *Its* Rept.-65SD4388
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71485) CFSTI: HC $7.00/MF $2.00 CSCL 22B

A functional description of the 1971 Voyager Flight Spacecraft concept selected as the preferred design is presented. Described are the mission objectives and design criteria; design characteristics; and restraints. System level functional requirements are given for the standard trajectories; spacecraft component design parameters; telemetry criteria; flight sequence of events; launch vehicle, capsule, science, and deep space network interfaces; layout and configuration; maneuver execution accuracy; and element identification.
L.S.

N66-21079*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PRELIMINARY DESIGN, VOLUME A (BOOK 3 OF 4): FLIGHT SPACECRAFT PREFERRED DESIGN—G AND C, PWR, ENG'G MECH, PROP
30 Jul. 1965 788 p refs Prepared for JPL *Its* Rept.-65SD4388
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71487) CFSTI: HC $10.88/MF $3.50 CSCL 22B

Subsystem level functional requirements for the guidance and control, and power subsystems; propulsion system; and engineering mechanics for the Voyager spacecraft are presented. Descriptions of the guidance and control subsystem include the attitude control, cold gas jet, autopilot, approach guidance, and articulation subsystems; and the control and sequencer. Engineering mechanics descriptions include the temperature control, and pyrotechnics subsystems; the spacecraft structure; electronic packaging and harnessing; the solar array structure; weight determination; planet scan platform; structural design criteria; and the high gain antenna deployment and gimbal mechanism.
L.S.

N66-21082*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PRELIMINARY DESIGN, VOLUME B (BOOK 1 OF 3): ALTERNATE DESIGNS CONSIDERED—SYSTEM ALTERNATES
30 Jul. 1965 431 p refs Prepared for JPL *Its* Rept.-65SD4388
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71490) CFSTI: HC $7.31/MF $2.25 CSCL 22B

The design approaches considered and the rationale used in selecting the preferred Voyager Spacecraft design are presented. Alternate mission objectives and design criteria are discussed. Alternate design characteristics are discussed for (1) flight spacecraft using Earth (two axes) and Mars (one axis) for attitude control references, (2) flight spacecraft using Mars local vertical stabilization, (3) flight spacecraft using radioisotope thermoelectric generators for primary power, (4) a microelectronic versus electronic piece part circuit tradeoff study, (5) computer application to circuit design, and (6) radiation analysis. Alternate system philosophies and system mechanizations are considered for (1) trajectory selection, (2) guidance, (3) mission sequences, (4) spacecraft configuration, and (5) propulsion, thrust vector control and auto pilot selection.
L.S.

N66-21084*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER SPACECRAFT SYSTEM. PRELIMINARY DESIGN, VOLUME B (BOOK 3 OF 3): ALTERNATE DESIGNS CONSIDERED—G AND C, PWR, C AND S, PROP, PLANS
30 Jul. 1965 623 p Prepared for JPL *Its* Rept.-65SD4388
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71492) CFSTI: HC $9.23/MF $3.00 CSCL 22B

Alternate designs for various subsystem mechanizations for the Voyager Spacecraft are discussed and described. Designs considered include the guidance and control, attitude control, cold gas jet, autopilot, approach guidance, controller and sequencer, articulation, temperature control, propulsion, and power systems. Also considered are electronic packaging, deployment and gimbaling for the high-gain antenna, the solar array structure, and the Planet Scan Platform. A discussion of the effects and implications of the various alternate designs on the Schedule and Implementation Plan is also given. L.S.

N66-21086*# General Electric Co., Philadelphia, Pa.
VOYAGER SPACECRAFT SYSTEM: PRELIMINARY DESIGN. 1969 TEST SPACECRAFT DESIGN, VOLUME D
30 Jul. 1965 560 p Prepared for JPL
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71494; DIN-65SD4388, Vol. D) CFSTI: HC $8.60/MF $2.75 CSCL 22B

A functional description of the 1969 Voyager test spacecraft is presented. This volume includes a discussion of mission objectives and design criteria, design characteristics and restraints, system functional requirements, subsystem functional requirements, and schedule and implementation plans. The mission suggested is an earth orbit to deep space flight. The spacecraft is to be launched by the Atlas/Centaur into an elliptical orbit, where it remains to conduct engineering tests for a period of two months. The spacecraft retropulsion system is then fired to place the spacecraft on a heliocentric orbit to simulate the cruise operation of the spacecraft in the 1971 mission. The differences between the proposed 1969 and 1971 missions are highlighted. The reasons used in deriving the described flight test mission, and the implications of using Saturn IB/Centaur rather than Atlas/Centaur as the launch vehicle in 1969 are appended. H.S.W.

N66-21088*# General Electric Co., Philadelphia, Pa.
VOYAGER SPACECRAFT SYSTEM: PRELIMINARY DESIGN. REPORT SUMMARY, VOLUME F
30 Jul. 1965 183 p Prepared for JPL
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71496; DIN-65SD4388, Vol. F) CFSTI: HC $5.00/MF $1.25 CSCL 22B

Technical considerations and implementation plans are summarized. The technical summary discusses the approach used in designing the Voyager spacecraft system, and briefly describes the 1969 and 1971 recommended spacecraft designs and the alternatives considered. The implementation summary reviews the methods considered to reduce the preliminary design to flight hardware. H.S.W.

N66-21089*# General Electric Co., Philadelphia, Pa.
VOYAGER SPACECRAFT SYSTEM: PHASE IA, TASK B, PRELIMINARY DESIGN. SPACECRAFT FUNCTIONAL DESCRIPTION, VOLUME A
31 Jan. 1966 410 p Prepared for JPL
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71497; DIN-65SD4514, Vol. A) CFSTI: HC $7.10/MF $2.00 CSCL 22D

Mission objectives and design criteria are presented on the 1971 Voyager flight spacecraft concept, selected as the preferred design. Details are given on the trajectory and guidance analysis, component design parameters, launch vehicle interface, flight capsule interface, the MOS/DSN interface requirements, experiment interface, telemetry data criteria, accuracy analyses, flight sequence, and layout and configuration. Functional descriptions are included on the telecommunication, radio, flight command, telemetry, and data storage subsystems. M.G.J.

N66-21090*# General Electric Co., Philadelphia, Pa.
VOYAGER SPACECRAFT SYSTEM, PHASE IA, TASK B: PRELIMINARY DESIGN. SPACECRAFT FUNCTIONAL DESIGN, VOLUME A, BOOK 2
31 Jan. 1966 548 p Prepared for JPL
(Contracts NAS7-100; JPL-951112)
(NASA-CR-71498; DIN-65SD4514, Vol. A, Bk. 2) CFSTI: HC $8.48/MF $2.75 CSCL 22B

Functional descriptions of the subsystems for the 1971 Voyager flight spacecraft concept are presented. Those subsystems described are: attitude control, autopilot, temperature control, spacecraft structure, pyrotechnics, electronic packaging, spacecraft harnessing, antenna actuation, solar array structure, power, computer and sequencer, midcourse orbit and adjust propulsion, and retropulsion. A plan for project implementation is also discussed. H.S.W.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-19799# Boeing Co., Seattle, Wash. Aero-Space Div.
RESPONSE OF LINEAR SYSTEMS TO MULTIPLE RANDOM DISTURBANCES
J. L. Ballinger and W. H. Harrell [1964] 8? p refs
(AS-1616)

This program finds the response of a system of linear differential equations that contain multiple random forcing functions. The forcing functions are input as power and cross spectral density functions; the response is in terms of frequency responses, power spectral density, an integrative measure and characteristic frequencies. Author

N66-19819# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
THE EFFECT OF THE SHEET WIDTH ON THE FATIGUE CRACK PROPAGATION IN 2024-T3 ALCLAD MATERIAL
J. Schijve, A. Nederveen, and F. A. Jacobs Mar. 1965 19 p refs Submitted for Publication
(NLR-TR-M.2142) CFSTI: HC $1.00/MF $0.50

The size effect on crack propagation was studied with sheet specimens of 2024-T3 Alclad. Values of the width were 80, 160, 300 and 600 mm, sheet thickness 3mm, mean

stress 8 kg/mm^2 and stress amplitudes 2.5, 4 and 6.5 kg/mm^2. Results are compared with the theory of the stress intensity factor and the Weibull theory. Practical implications of the results are indicated. Author

N66-19841 Radio Corp.of America. Princeton, N. J. Astro-Electronics Div.
EFFECT OF STRUCTURAL FATIGUE ON MECHANICAL DESIGN OF SPACECRAFT
Joseph J. Frank *In its* Space Electron. 1965 p 61-63 refs (See N66-19827 10-31)

In the mechanical design of spacecraft, it is very important that the fatigue effects on the structure be thoroughly considered during the design process. This paper briefly discusses input loadings and responses (including construction of an experience table), theoretical analysis of fatigue stresses, and then presents a practical satellite design problem to illustrate the design process followed. Author

N66-19911# Illinois Univ., Urbana.
TREATMENT OF RELEASES AND CONSTRAINTS IN THE NETWORK FORMULATION OF STRUCTURAL ANALYSIS Progress Report, Sep. 1964–Sep. 1965
Steven J. Fenves, Samuel P. Mauch, and Ravtndar K. Kinra Oct. 1965 79 p refs *Its* Structural Res. Ser. no. 299
(Contract Nonr-1834(03))
(AD-626214) CFSTI: HC $3.00/MF $0.75

In the hitherto developed network-topological formulation of linear structural analysis each member and each support joint was assumed to provide full fixity in all directions considered, and all distortion components in a member were incorporated in the stiffness or flexibility matrix of the member. In actual structures it is often desirable to prescribe additional conditions on individual force or displacement vector components. The network formulation is extended so that arbitrary specifications of releases and constraints for both members and joints can be incorporated into the general formulation without destroying its simplicity and compactness. As a special case of joint releases, a convenient procedure for the treatment of symmetrical and antisymmetrical structures is described. The theory is developed for both the stiffness and flexibility methods; however, only the implementation of the stiffness formulation has been carried out and is presented herein. Author (TAB)

N66-19956# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE INFLUENCE OF LOAD ALTERNATION ON THE FATIGUE STRENGTH AND LONGEVITY OF COMPONENTS WITH AND WITHOUT STRESS CONCENTRATION. COMMUNICATION II
V. M. Grebenik and V. F. Kucherenko 3 Dec. 1965 14 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chern. Met. (Moscow), no. 8, 1964 p 188-194
(FTD-TT-65-1071/1+2; AD-625147) CFSTI: HC $1.00/MF $0.50

Fatigue strength and stress regimes of notched and smooth specimens of carbon steel and alloy steel were tested by cyclic alternating loads of increasing durations and by a single-step, one-time change in the load cycle. The final number of stress cycles that the specimen withstood in working to failure was determined by varying the duration of the initial condition, the stress difference in load levels, and the final number of load stress cycles. It was found that cyclic load fatigue strength variations depended heavily on the steel properties. Carbon steels showed a higher cyclic strength than alloy steels; soft low-carbon steels were less sensitive to cyclic loads than strong and hard steels. Increased stresses resulted in higher softening effects for all tested specimens; smooth specimens showed a stronger softening effect under a single-step, one time load change than the notched samples. G.G.

N66-20011# Bureau of Mines, Pittsburgh, Pa.
STRESS WAVES IN BOUNDED MEDIA Quarterly Report, 1 Sep.–30 Nov. 1965
Richard W. Watson, Karl R. Becker, Frank C. Gibson 7 Jan. 1966 19 p Prepared for Aberdeen Proving Ground
(AD-626415) CFSTI: HC $1.00/MF $0.50

The program to determine the factors affecting the energy transferred from detonating explosives to coupled metal plates was continued. The variables under consideration include the properties of the explosive as well as the choice of materials in the explosive-plate combination. The latter involves the shock impedance match between the explosive and metal plate, as well as the effects of charge geometry and the degree of coupling between the explosive and the plate. An effort was made to improve the precision of the observations. In addition, several groups of firings were completed using five explosives in combination with four different plate materials. The results of these tests are discussed. TAB

N66-20022# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
THE THICKNESS EFFECT AND PLASTIC FLOW IN CRACKED PLATES Scientific Report, Dec. 1960–Jun. 1964
Jerold L. Swedlow Wright-Patterson AFB, ARL, Oct. 1965 146 p refs
(Contract AF 33(616)-7806)
(ARL-65-216; AD-626986) CFSTI: HC $4.00/MF $1.00

In structure having high strength/weight ratios, the presence of material or mechanical imperfections can reduce the capability of the structure to perform as intended. Although large flaws can be detected and repaired, the possibility of smaller ones which might trigger fracture must be taken into account. Integrity of the overall structure therefore rests upon the ability to predict that size and geometry which can become critical when subjected to design stresses. Author (TAB)

N66-20072*# Alabama Univ., University. Bureau of Engineering Research.
AN ASYMPTOTIC SOLUTION OF CONICAL SHELLS OF CONSTANT THICKNESS Progress Report No. 6
Chin Hao Chang and Han Yun Chu Dec. 1965 41 p refs With Computer Programs For Progress Reports 1, 2, and 6
(Contract NAS8-11155)
(NASA-CR-71023) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A solution of truncated conical shells of constant thickness is obtained as the ratio of the thickness to the radius at the larger end goes to zero asymptotically by separating the solution into two parts: membrane and bending. These two parts are coupled by the lateral displacement. A particular solution due to lateral normal loads is also given and two numerical examples are presented. One numerical example considers a semicircular shell segment with the smaller end fixed, the other end free and the two generator edges simply supported. The shell is subjected to a lateral normal load which is constant in the meridional direction and varies sinusoidally in the circumferential direction. The other numerical example considers a cantilevered complete cone with the larger end free. A rigid plate is attached to the free end and a moment is applied. Comparisons with other available results are given in both examples. Author

N66-20087 Technical Univ. of Istanbul (Turkey).
ON THE VIBRATION OF BEAMS CARRYING AN ARBITRARY NUMBER OF CONCENTRATED MASSES [MUNFERIT KUTLELER TASIYAN KIRISLERIN TITRESIMLERI]
Chintakindi L. Amba-Rao and Erdogan S. Suhubi *In its* Bull. of the Tech. Univ. of Istanbul 1965 p 7–16 refs (See N66-20086 10-34) CFSTI: HC $4.00/MF $0.75

An easy solution is given to the problem of the free vibrations of simply supported beams carrying an arbitrary number of concentrated masses located in an arbitrary way. Finite Fourier sine transforms and the modification of the beam to a variable density beam by the introduction of Dirac δ-functions are utilized in the solution of the problem. The simplified frequency equations corresponding to (i) a single concentrated mass in the middle of the beam and (ii) two equally spaced identical concentrated masses are given. For the latter case some of the roots of the frequency equation are numerically evaluated. Author

N66-20091# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUATIONS OF TRANSVERSE VIBRATIONS OF FLUID-FILLED SHELLS
B. I. Rabinovich 19 Oct. 1965 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. i. Mashinostr. (Moscow), no. 1, 1964 p 166–169
(FTD-TT-65-869/1+2+4; AD-625052) CFSTI: HC $1.00/MF $0.50

Transverse vibrations of thin-walled cylindrical shells having circular cross sections and filled completely or partially with an ideal incompressible fluid were investigated, and expressions for displacement potentials that satisfy the boundary conditions for the case of a fluid of any depth are given. Utilized was a cylindrical coordinate system for determining the boundary value problem of the fluid particle displacement potential. The Lagrange-Gauchy integral was used to find the hydrodynamic pressure on a shell, the shell equations, and the dynamic boundary condition on the free surface of the fluid, and to develop a system of equations in transfer components, describing the vibrations of a shell and fluid. Example calculations for the frequencies and vibration shapes of a shell completely filled with a fluid are included. G.G.

N66-20096# Stanford Univ., Calif.
THE EFFECTS OF PLASTICITY ON THE BUCKLING AND POSTBUCKLING OF CIRCULAR CYLINDRICAL SHELLS
Alan Miller Edwards (Ph.D. Thesis) Jun. 1965 138 p refs (Contract AF 33(608)-1114)
(AD-624660) CFSTI: HC $4.00/MF $1.00

The influence of plasticity on the buckling of shell bodies was studied to discover at what stage of the buckling process plastic effects become important, to determine the nature of these effects, and to correlate the elastic and plastic buckling of cylindrical shells from an experimental viewpoint. It was shown that the buckle shape of cylinders under axial compression changes from the diamond to the ring type as the pressure axial load ratio increases and that diamond and ring patterns can be simultaneously achieved. Buckling of thick-walled cylinders demonstrated that axissymmetric ring-shaped buckling can develop into nonsymmetric plastic buckling modes immediately without any prior axissymmetric buckling. Borderline cases between thick-walled plastic and thin-walled elastic shells were induced to buckle progressively in the plastic range when there were regions in the shell in which low mechanical properties or inelastic behavior due to stress concentrations are present. These conditions led to the formation of plastic hinge lines and an inextensional deformation pattern. G.G.

N66-20129*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ANALYTICAL PROCEDURE FOR DETERMINING RANDOM LOAD ACTING ON A SPACECRAFT DUE TO A PRIMARY RANDOM LOAD ACTING ON AN EXTERIOR STRUCTURE Quarterly Report No. 2, 1 Sep.–30 Nov. 1965
Richard H. Lyon and Jerome E. Manning [1965] 58 p refs (Contract NAS5-9601)
(NASA-CR-71037) CFSTI: HC $3.00/MF $0.50 CSCL 20K

This report continues our discussion of sound and vibration transmission in a model of the OGO spacecraft-shroud system. The basic formulas and concepts that are used to predict sound transmission were previously developed. In the present report, we continue the development with a calculation of spacecraft-to-shroud vibration ratios for mechanically transmitted energy. A calculation of the noise reduction of the fiberglass shroud is also included. An experimental study of acoustical and vibrational energy transfer in the OGO system should provide an extremely useful adjunct to theoretical analyses. A series of experimental studies are outlined that are designed to test and to complement the theoretical calculations. As complete a series of experiments as possible is desirable so that most of the important structural and interstructure coupling parameters could be determined completely from the experimental analysis. In this way, one does not have to rely on the theoretical estimates for prediction of energy transmission. Author

N66-20137*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
APPLICATION OF DISTRIBUTED SYSTEM CONCEPTS TO DYNAMIC ANALYSES AND CONTROL OF BENDING VIBRATIONS
David R. Vaughan Aug. 1965 118 p refs (Contract NAS8-11420)
(NASA-CR-71000; SM-48759) CFSTI: HC $4.00/MF $0.75 CSCL 20K

The problem treated in this work is twofold: achieving a desired motion of a flexible structure rapidly and with minimum vibration or ringing, and minimizing excursions from the desired motion caused by unpredictable loads. The problem is approached through an analogy to propagation and reflection of flexural and longitudinal waves. The input-impedance matrix for transverse vibration of a semi-infinite beam is found to contain the operators $\sqrt{s}$ and $1/\sqrt{s}$. This leads to an investigation of the effectiveness of these operators in the terminal-impedance matrices of vibration dampers or active controls. The concept of a reflection matrix is introduced and related to the terminal-impedance matrix. Several different terminal-impedance matrices are considered. For these cases, responses to commands and load disturbances are studied in the time domain by analog simulation, and in the frequency domain. An attempt to correlate the behavior of these systems with their reflection matrices is only partially successful. Considerable attention is devoted to the longitudinal traveling wave solution for beams, because its treatment is closely analogous to that of flexural wave propagation. R.N.A.

N66-20156# Naval Civil Engineering Lab., Port Hueneme, Calif.
CRITICAL PRESSURES FOR RADICALLY SUPPORTED CYLINDERS Final Report

C. V. Chelapati Jan. 1966 75 p refs
(N-773; AD-627082) CFSTI: HC $3.00/MF $0.75

A study is made to find the critical pressures for radially supported cylinders with simple ends and subjected to uniform radial pressure. The large deflection theory developed by Langhaar and Boresi is used to find (1) the critical pressures, considering only infinitesimal deflections (Euler load), and (2) the critical pressures for snap-through buckling (energy load of Tsein's critical pressure). Two types of radial supports are utilized in this study. The first type, designated by 'elastic foundation,' is used when the support exhibits linear spring characteristics in both tension and compression. The second type, designated by 'soil foundation,' is used when the support exhibits linear spring characteristics only in compression and offers no resistance while in tension, thus representing the behavior of soil more closely. It is found that the critical pressure coefficient is a function of the length-to-radius ratio, radius-to-thickness ratio, and the coefficient of foundation. It is shown that energy loads occur for relatively short, thin, and lightly supported cylinders. In other cases energy loads and Euler loads are found to be quite close. Cylinders supported by soil foundations have lower critical pressures than cylinders supported by elastic foundations and are also susceptible to snap-through over a wider range of parameters. The number of waves in the buckled cylinder is in general smaller for energy loads than for Euler loads. Graphs are given showing energy and Euler loads over a wide range of parameters. A few tabulated results also are given for representative cases. Analytical results are compared with Bulson's experimental data on buried cylinders. Author (TAB)

N66-20199# Lockheed Missiles and Space Co., Sunnyvale, Calif.

CERTAIN QUESTIONS OF SHELL DYNAMICS

O. V. Luzhin [1964] 11 p refs Transl. into ENGLISH from the publ. "Theory of Plates and Shells" (Erevan), 1964 p 652-657

Strained and stressed states of shells of revolution were studied by means of analogous formulas represented in the form of initial parameters when the arbitrary constants were the kimatic and form factors. A matrix expression was obtained that permitted the findings of the displacements and forces in any section of the shell if the free-vibration frequency and the initial parameters were known. This transition matrix description was also used to establish the connections between the displacements and the forces at the endplates of two adjacent parts of the shell. Frequency spectra and the modes of spherical shell vibrations were obtained by digital computer for a hemisphere of 12.5 cm radius and 0.25 cm thickness. Vibrations were excited symmetrically by loading and photographed on the screen of a cathode ray oscilloscope. The vibrations had the character of a beat with the period 1.07×10^{-3} sec; the period of one vibration was 0.132×10^{-3} sec. G.G.

N66-20203# Lockheed Missiles and Space Co., Sunnyvale, Calif. Aerospace Sciences Lab.

AN INVESTIGATION OF THE PANEL COLLAPSE STRENGTH OF STIFFENED PLASTIC HEMISPHERES

E. H. Nickell and J. Skogh 1 Oct. 1965 32 p refs
(LMSC-6-75-65-53)

Sixteen 18 in. diameter plastic hemispheres were tested to determine a method of analysis for predicting the collapse strength of panels between the ribs of a stiffened dome. Four hemispheres were unstiffened and 12 hemispheres were stiffened. All of the hemispheres were tested to failure by subjecting them to an external crushing pressure. The results show that: (1) Panels between stiffeners of spherical shells can collapse at higher stresses than unstiffened shells. (2) The collapse stress of panels between stiffeners can be predicted by an empirical equation. (3) The assumption that panels between stiffeners buckle as flat plates with simply supported edges is too conservative. (4) Panel bending stresses can be important for structures subjected to repeated loading conditions yet they may not influence the collapse strength. (5) Elastic buckling can occur for very shallow spherical panels. (6) Epoxy resin is a satisfactory material for experimental models requiring high yield strength to density buckling characteristics. Author

N66-20207# California Univ., Berkeley. Lawrence Radiation Lab.

TENSION WIRE SUPPORT STRUCTURES. PART I: A PARAMETRIC STUDY OF TENSION WIRE SUPPORT FOR INSTRUMENTATION Final Report

J. Frisch and R. F. Steidel, Jr. May 1965 68 p refs
(Contract W-7405-ENG-48)
(UCRL-13160, Pt. 1; MD-65-3) CFSTI: HC $3.00/MF $0.75

A study was made of tension wires as an alternative method of support for a sphere within an outer cylinder. The geometries of the wire-sphere support system are defined, and a sphere deflection theory was developed and verified experimentally with static loading. An odd number of wires is used for radial symmetry in the theory. The stress concentration at wire intersections can be reduced by padding. NSA

N66-20257# California Univ., Livermore. Lawrence Radiation Lab.

HIGH TEMPERATURE PLASTIC DEFORMATION OF POLYCRYSTALLINE BERYLLIUM OXIDE

Willis L. Barmore and Richard R. Vandervoort 25 Jun. 1964 30 p refs
(Contract W-7405-ENG-48)
(UCRL-7202) CFSTI: HC $1.00/MF $0.50

High density specimens were plastically deformed under four-point transverse bending. Tests were conducted in vacuum in the temperature region 1400 to 1700°C under stresses ranging from 1000 to 4500 psi. The activation energy for creep was 99.0 kcal per mole. Creep rate was directly proportional to the applied stress and inversely proportional to the square of the grain diameter. The deformation behavior is ascribed to a Nabarro–Herring type mechanism. Results show that creep in tension and compression were the same. Author (NSA)

N66-20318# Sandia Corp., Albuquerque, N. Mex.

A STUDY OF IMPACT EFFECTS ON SPHERICAL SHELLS Quarterly Progress Report No. 6, 1 Feb.–30 Apr. 1965

Charles E. Stoneking [1965] 12 p ref
(Contract AT(29-1)-789)
(SC-DC-65-1634) CFSTI: HC $1.00/MF $0.50

A research program is being conducted on the structural integrity of hollow spheres when they are impacted against rigid targets. Progress is reported on the theoretical analysis of cylinders, on the theoretical analysis of hollow spheres, and on the experimental part. NSA

N66-20354# California Univ., Berkeley. Lawrence Radiation Lab.

TENSION WIRE SUPPORT STRUCTURES. PART 3: THE DESIGN AND STATIC TESTING OF THE FINAL ASSEMBLY Final Report

J. Frisch and R. F. Steidel, Jr. May 1965 67 p refs
(Contract W-7405-ENG-48)
(UCRL-13160, Pt. 3) CFSTI: HC $3.00/MF $0.75

The wire size and number and wire attachment design in the tension wire-sphere support structure in an outer cylindrical shell were investigated. The information developed in this part and parts 1 and 2 was used to determine the specifications for a final assembly. This final assembly was tested. NSA

N66-20374# California Univ., Berkeley. Lawrence Radiation Lab.
TENSION WIRE SUPPORT STRUCTURES. PART 2: ENERGY ABSORPTION IN A CYLINDRICAL SHELL UNDER TENSION WIRE LOADS Final Report
J. Frisch and R. F. Steidel, Jr. May 1965 69 p refs
(Contract W-7405-ENG-48)
(UCRL-13160, Pt. 2; MD-65-3) CFSTI: HC $3.00/MF $0.75

For a suspended package to withstand shock, means must be provided for absorbing kinetic energy. In the tension wire-sphere support structure studied in Part 1, little or no energy can be absorbed in the wires. The possibility of absorbing some of the kinetic energy as strain energy in the supporting (outer) cylindrical shell is studied. A relation between the edge loadings and the induced elastic strain energy is established, and an attempt is made to attach the supporting wires optimally for maximum storage of energy in the shell. (NSA)

N66-20397# Sandia Corp., Albuquerque, N. Mex.
AN APPROACH TO THE STIFFNESS OF LATERALLY LOADED CONICAL SHELLS
A. J. Leineweber Aug. 1965 12 p refs
(Contract AT(29-1)-789)
(SC-TM-65-82) CFSTI: HC $1.00/MF $0.50

Beginning with the equilibrium equations for a shell of revolution in which general lateral loading and bending stresses are considered, force-displacement relations for a conical shell are obtained and expressed in finite difference form. From this set of equations, the stiffnesses for the conical shell are determined. Author (NSA)

N66-20438# Sandia Corp., Livermore, Calif.
DYNAMIC LOADING OF A CYLINDRICAL SHELL
C. W. Robinson Jan. 1965 26 p refs
(Contract AT(29-1)-789)
(SCL-DR-64-113) CFSTI: HC $2.00/MF $0.50

The equations of motion for a long cylindrical shell are solved for the case of a pressure load which varies independently with angle and time. The solution is obtained by superimposing two approximate solutions. Expressions for the stress and displacements are derived in series form, and insignificant terms of the series are eliminated. Author (NSA)

N66-20471# California Univ., Livermore. Lawrence Radiation Lab.
ENGINEERING APPLICATION OF WEIBULL STATISTICS
E. Y. Robinson 16 Feb. 1965 48 p refs Presented at ASME, Berkeley, Calif.
(Contract W-7405-ENG-48)
(CONF-650607-1; UCRL-12405) CFSTI: HC $2.00/MF $0.50

The Weibull theory is an attempt to account for the variability of measured strength in "brittle" material. It is not of general applicability although there are many cases where the theory is satisfactorily confirmed by experimental evidence. Its qualitative aspects are frequently confirmed. Even in its simplest form, the theory may be used to approximate fairly complex data and is amenable to the development of conservative but meaningful design rules. Some methods are reviewed for analyzing data in terms of the Weibull distribution, and a convenient normalized expression is given. Formulas are given for the statistical behavior of the weakest specimens in a given sample and the application is demonstrated using data on beryllia and alumina. Brief consideration is given to proof-test (truncation) and bias (pre-stress or axis-shift) and the effects on a "primitive" (unbiased, untruncated) sample. Author (NSA)

N66-20483# Sandia Corp., Albuquerque, N. Mex.
FORCE-CONTROLLED VIBRATION TESTING
J. V. Otts Feb. 1965 36 p refs
(Contract AT(29-1)-789)
(SC-TM-65-31) CFSTI: HC $2.00/MF $0.50

A discussion is presented of the concept of force-controlled vibration testing, where the input force is controlled into a test system which includes not only the test item but a mass which represents the test item's foundation. The fundamental response characteristics for this type of test are presented and compared with those resulting from motion-input controlled tests. In addition, the methods used in determining the force input spectrum and the magnitude of mass, which simulates the foundation, are considered. Author (NSA)

N66-20604# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Mechanical Engineering.
APPLICATION OF VARIATIONAL EQUATION OF MOTION TO THE NONLINEAR ANALYSIS OF DYNAMIC BUCKLING Scientific Report No. 4
Yi-Yuan Yu Jun. 1965 25 p refs
(Contract AF 49(638)-1290)
(AFOSR-65-1421; AD-627961) CFSTI: HC $1.00/MF $0.50

An integrated procedure has been proposed for applying the variational equation of motion to the analysis of nonlinear vibrations of solids. In this paper the procedure is extended to the analysis of nonlinear dynamic buckling. Example is given for a simply supported sandwich or homogeneous plate in plane-strain motion, one edge of which is fixed and the other subjected to a longitudinally oscillating displacement. Response curves for the parametrically excited, lateral vibration corresponding to the first instability region are presented. Results show that the transverse shear effect cannot be neglected for the sandwich plate, as in the case of ordinary, nonlinear lateral vibration of the plate. The transverse shear effect is, however, negligible for the homogeneous plate (Timoshenko beam), at least for the first instability region. Author (TAB)

N66-20630# General Electric Co., Philadelphia, Pa. Missile and Space Div.
RESPONSE OF SHELLS TO STEADY AND NONSTEADY TEMPERATURE FIELDS
Ewald Heer Dec. 1965 32 p refs
(R65SD63)

Rapidly changing thermal environments often cause temperature induced vibrations in thin surface structures such as plates and shells. Because of the frequent use of these structural elements in missiles and space vehicles, a general approach to the analysis of these response problems having conceptual simplicity is presented. Considering thin shells of arbitrary shape, "equivalent loads" on the shell surface and at the shell edges, resulting from arbitrary temperature variations in space and time, are derived. Assuming that for a given shell the modes of free vibrations can be determined exactly or approximately, the generalized forces become sums of surface and line integrals, where the forms of the latter are determined at every point at the shell edge by the middle surface temperature distributions and by the geometric boundary conditions. Numerical results of quasi static and

dynamic responses of several simply supported shallow shells, differing only in their curvatures and subjected to a sudden temperature difference through the shell thickness, are presented for the first few modes for a range of physical parameters. The results show a pronounced effect of the curvatures of shells on the maximum response. Author

N66-20712# Naval Ordnance Lab., White Oak, Md.
FEASIBILITY STUDY OF PLASTIC-CLAD GLASS CAPSULES FOR DEEP-DIVING SUBMERSIBLES
W. B. Coffman, R. S. Allgaier, E. L. Criscuolo, V. C. Dawson, L. C. Fisher et al 3 Jun. 1965 102 p refs
(NOLTR-65-76; AD-618480) CFSTI: HC $4.00/MF $0.75

A study was made to determine what, if any, further applied research and exploratory development are required prior to development of a full-scale, manned plastic-clad glass capsule as part of a deep submersible. The theoretical advantages are numerous and the available experimental information is encouraging; however, more tests on larger-scale models and more fundamental engineering information on glass properties is required to permit design with confidence. Author (TAB)

N66-20820# State Univ. of New York at Buffalo. Div. of Interdisciplinary Studies and Research.
EFFECT OF RANDOM TEMPERATURE DISTRIBUTIONS ON CREEP IN CIRCULAR PLATES
T. T. Soong and F. A. Cozzarelli Oct. 1965 34 p refs
(Contract Nonr-4449(00); Grant NSF GK-17)
(Rept.-7; AD-625686) CFSTI: HC $2.00/MF $0.50

An analysis is presented concerning creep bending of circular plates with a randomly varying temperature distribution. Analytical and numerical results are presented on the statistical properties of the radial moment, circumferential moment, and lateral deflection. It is shown that the radial and tangential moments are relatively insensitive to random variations in the temperature distribution. The statistical distribution of the lateral deflection is derived analytically in a simple and general form. Author (TAB)

N66-20828# Massachusetts Inst. of Tech., Cambridge.
INELASTIC EFFECTS IN RANDOM VIBRATION
Dean Karnopp Oct. 1965 22 p refs
(Contract AF 49(638)-1314)
(AFOSR-65-1915; AD-626691) CFSTI: HC $1.00/MF $0.50

A procedure is given by which the vibration of systems containing inelastic elements which exhibit interface slippage or plastic yielding may be visualized and through which estimates of average amplitudes of vibrations as well as average rates of accumulation of plastic strain may be found. The method involves power balances and is most easily applied in the case of broad band excitation. The type of computations required are illustrated by means of a single degree of freedom example and two degree of freedom example systems are shown to illustrate the extension of the procedure to multi-degree of freedom problems. Author (TAB)

N66-20830# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
COMPOSITE MODAL CHARACTERISTICS OF MULTI-SECTION, ELASTIC SPACE STRUCTURES
Charles W. Coale Aug. 1964 34 p refs
(LRC-65-190; AD-626304) CFSTI: HC $2.00/MF $0.50

Analysis of the dynamic response of complex structures requires knowledge of the dynamic characteristics of the structure. In many cases a structure is composed of several sections and may be considered to behave linearly. In this report a new method is evolved for analysis of the flexible dynamic characteristics of such structures. A matrix eigenvalue equation is derived for determination of the modal characteristics of the composite structure in terms of the characteristics of its sections. Use is made of functional vector modes to describe modal behavior of the sections in three-dimensional space. The problem is then formulated in terms of modal and rigid body coordinates of the sections. The eigenvalue equation is derived by application of Lagrange's equations. The connection conditions between sections provide relations between the coordinates. These relations are used to reduce the size of the matrices involved. The method is developed for a tandem series of sections. It may however be extended to multibranch structures. An essential modification of this analysis is also presented. For many applications a large number of section modes are required for good convergence of the composite modal characteristics. Consideration is therefore given to quasistatic behavior of the sections under the loads applied during composite motion. Additional quasistatic coordinates are introduced into the eigenvalue analysis yielding a remarkable improvement in convergence in some cases. Author (TAB)

N66-20867*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DEVELOPMENT OF THERMAL PROTECTION SYSTEM FOR A CRYOGENIC SPACECRAFT MODULE Monthly Progress Report, No. 19, 31 Dec. 1965–31 Jan. 1966
(Contract NAS3-4199)
(NASA-CR-71165) CFSTI: HC $1.00/MF $0.50 CSCL 22B

Work progress on the development of a thermal protection system for a cryogenic spacecraft module included a ground-hold test on the half-scale module. Preliminary test data indicated that the surface temperatures of the purge substrate were below nitrogen liquification temperature. Hydrogen boil-off rates decreased with time from about 64 pounds per hour to about 40 pounds per hour, after six hours. An orbital heat-flux simulation test to evaluate the insulation system under vacuum conditions found an equilibrium hydrogen boil-off rate of 0.65 pound/hour. G.G.

N66-20912# Federal Aviation Agency, Washington, D. C.
SONIC BOOM STRUCTURAL RESPONSE TEST PROGRAM, WHITE SANDS MISSILE RANGE, NEW MEXICO Preliminary Data, Nov. 1964–Feb. 1965
17 Mar. 1965 19 p
(SST-65-4)

Tests were conducted to determine the sonic boom overpressure damage index level associated with various types of structural material, such as plaster, glass, and masonry. The program operations schedule included 30 sonic boom runs per day, seven days per week, for a total of 1494 sonic boom runs generated by F-104 and B-58 aircraft. The test site is described, and information on the structures is tabulated. Preliminary findings show: (1) Poorly applied plaster on wood lath is the minimum type wall finishing material observed. Booms may cause unseen cracks at nominal 6.5 psf, with real damage occurring at a nominal overpressure level of 10.0 psf. (2) Damage to gypboard is characterized mainly by slight nail popping; this condition begins to accelerate by booms of approximately 8 psf. (3) Booms of 8 psf will begin to extend old pre-damaged bathroom tile cracks. (4) Minimum glass may break at a nominal pressure of 10 psf. (4) Precariously balanced bric-a-brac attached to walls of loose structures may fall at about 6.0 psf peak. M.G.J.

N66-20943*# Utah Research and Development Co., Inc., Salt Lake City.

EFFECTIVENESS OF ALUMINUM HONEYCOMB SHIELDS IN PREVENTING METEOROID DAMAGE TO LIQUID-FILLED SPACECRAFT TANKS Final Report

Dec. 1964 32 p

(Contract NAS9-3585)

(NASA-CR-65261) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Simulated tests of the effects of meteoroid impact on liquid filled spacecraft tanks were made by shooting projectiles from a light-gas gun into a titanium window on a pressurized water filled tank. Aluminum balls 1/8" and 3/16" diameter were used as projectiles at impact velocities of about 22,000 ft/sec. The shield consisted of aluminum honeycomb material cemented between sheets of aluminum. Impacts were made at angles of 90°, 65°, 45°, 30°, and 20° to the surface of the shield. Shields were spaced 3/8" and 2" from the tank surface. The shields were found to be effective in shattering the projectile and scattering impact debris over a wide area on the tank skin, particularly with 2" spacing between shield and tank. The titanium tank walls were tensile tested to determine weakening caused by impact debris in cases where penetration did not occur. It was found that widely dispersed impact debris did not significantly affect the tank strength. Concentrated debris causing obvious damage weakened the material.

Author

N66-20946# Lockheed Missiles and Space Co., Sunnyvale, Calif.

SELECTED PAPERS FROM A CONFERENCE ON STABILITY PROBLEMS IN STRUCTURAL MECHANICS

V. V. Bolotin, I. M. Rabinovich, and A. F. Smirnov, ed [1965] 324 p refs Transl. into ENGLISH of the book "Problemy Ustoichivosti v Stroitel'nom Mekhaniki" Moscow, Stroiizdat., 1965

Selected articles on stability problems in structural mechanics are presented. For individual titles see N66-20947–N66-20976.

N66-20947 Lockheed Missiles and Space Co., Sunnyvale, Calif.

THEORY OF STABILITY AND PRINCIPLES OF THE ANALYSIS OF STRUCTURES

B. M. Broude *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 22–37 refs (See N66-20946 10-32)

Compressed-bent rods, rod systems, plates, and shells are considered as illustrations of the principles of analysis of structures as related to the theory of stability. Attention is given to buckling in the force plane, central compression, biaxial eccentricity, and bending-twisting buckling mode; and the influence of residual stresses due to welding, cold rolling, and cold trimming is considered. It is pointed out that there is a significant gap between theory and computational practice. M.W.R.

N66-20948 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE ANALYSIS OF COLUMN STRUCTURES WORKING IN THE ELASTIC-PLASTIC STAGE

A. V. Gemmerling *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 38–43 (See N66-20946 10-32)

Specific peculiarities are considered for the buckling phenomena of column systems working in the elastic-plastic stage. These include the different values of the stiffness determining the deformability and stability of the system, the possibility of buckling for strain modes not possible in the elastic stage, and the unique behavior of a compressed-bent elastic-plastic column in the post-critical stage. Graphs are presented which indicate that the compression stiffness of an eccentrically compressed column diminishes continuously while the compressive force grows. It is shown that the resistivity of a column in a T-shaped frame can be measured from the horizontal axis in the post-critical stage; and this total resistivity is always positive. The stiffness and resistivity of the supporting system, loaded by a force thrown off by the buckling column, will determine if the system can work in the post-critical stage or if it will go into new equilibrium states. M.W.R.

N66-20949 Lockheed Missiles and Space Co., Sunnyvale, Calif.

SOME QUESTIONS OF THE QUALITATIVE THEORY OF STABILITY OF ELASTIC SYSTEMS

I. I. Gol'denblat *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 44–57 (See N66-20946 10-32)

In order to estimate the value of the methods and concepts introduced by Poincare, the method of stability coefficents is considered. It is assumed that the system has a finite number of degrees of freedom; and, in practice, any elastic column may be reduced to such a system by introducing a sufficient number of stiff columns connected by elastic constraints. Imaginary stability coefficients and associated transformations are discussed. Possibilities of using topological methods in the theory of equilibrium and the stability of elastic systems are investigated for systems having (1) a finite number of degrees of freedom and (2) two degrees of freedom, where three nondegenerate equilibrium positions are possible, and (3) three degrees of freedom with four equilibrium positions. M.W.R.

N66-20950 Lockheed Missiles and Space Co., Sunnyvale, Calif.

STABILITY OF ELASTIC SYSTEMS UNDER DYNAMIC LOADINGS

G. Iu. Dzhanelidze *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 58–74 refs (See N66-20946 10-32)

A general discussion is presented on the theory of stability of elastic systems under various kinds of dynamic loadings. Attention is given to dynamic stability as well as the dynamics of elastic systems under rapid loading. Stability of nonconservative systems is also considered, and it is pointed out that the bifurcation and energy stability criteria may not be suitable in such cases. The nature of the buckling determines the applicability of the stability criteria. Consideration is given to stability of a cantilever under the effect of a force following the tangent to the elastic line at the end of the rod either by lagging or leading. M.W.R.

N66-20951 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE THEORY OF QUALITATIVE METHODS IN PROBLEMS OF ELASTIC STABILITY

Ia. L. Nudel'man *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 75–81 (See N66-20946 10-32)

Criteria are proposed to confirm the closeness of structures that differ only by the distribution law of the longitudinal forces. A method is given to construct structures whose critical forces are either more or less than the desired critical force of the given structure. In either case, the directed change in the stability of the structure must be achieved by

the simultaneous application of both compressive and tensile forces. Results, formulated for the longitudinal bending of rectilinear rods, are considered applicable for all stability problems which reduce to an integral equation with a positive-definite kernel. The findings may also be extended to problems in which the transition from a complex to a simple system is accomplished by a transformation of the structure. M.W.R.

N66-20952 Lockheed Missiles and Space Co., Sunnyvale, Calif.

BEHAVIOR OF CYLINDRICAL SHELLS UNDER LONGITUDINAL IMPACT

V. L. Agamirov and A. S. Vol'mir *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 93–100 refs (See N66-20946 10-32)

An investigation is made of the behavior of a shell clamped at one end and receiving the longitudinal impact of a rigid mass at the second endplate. Initial imperfections in the shape of the middle surface of the shell are accounted for, and amplitudes of initial and later dents are assumed comparable to shell thickness. Approximate solutions are proposed which permit utilization of methods used in static problems; and the results of computations performed on electronic digital computers are compared with experimental data. These experiments indicate that the general nonlinear formulation of the problem of shell buckling under impact loadings is justified. M.W.R.

N66-20953 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE INFLUENCE OF ELASTIC FIXING OF THE EDGES OF A CYLINDRICAL SHELL IN THE AXIAL DIRECTION ON THE VALUE OF THE UPPER CRITICAL PRESSURE

N. A. Alfutov *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 101–105 refs (See N66-20946 10-32)

Consideration is given to a shell for which the elastic fixings hinder plane deformations but do not affect the subcritical state of the shell. Axial bending and twisting moments, peripheral elongations and angles of shear of the middle surface, and the Poisson coefficient of the shell material are all assumed to be zero. On the basis of these assumptions and by using equilibrium equations, the fundamental equation is obtained and its is possible to determine displacements and axial and shear stress resultants. An equation and boundary conditions are evolved which agree with those for a freely vibrating homogeneous beam, for which elastic fixing of the beam end relative to the displacement corresponds to the elastic fixing of the shell edge in the axial direction. An expression for the critical pressure is obtained which may also be used for orthotropic shells. Also considered are a beam with hinge-supported edges, one of which is fixed elastically relative to angular displacements; a beam with one rigidly framed end and the other hinge-supported; and a beam with one free end and the other hinge-supported. M.W.R.

N66-20954 Lockheed Missiles and Space Co., Sunnyvale, Calif.

EXPERIMENTAL INVESTIGATIONS OF THE STABILITY AND CARRYING CAPACITY OF RIBBED CYLINDRICAL SHELLS

I. Ia. Amiro, V. A. Zarutskii, and P. S. Poliakov *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 106–111 refs (See N66-20946 10-32)

Experiments are conducted on the nature of buckling and the depletion of the carrying capacity of ribbed, closed cylindrical shells as a function of the number of longitudinal reinforcing ribs. Shells were fabricated from a rolled sheet by using point electric welding. Longitudinal ribs were placed on the outer surface, annualr ribs on the inner; and hermetic sealing was obtained with special seals mounted on the shell endplates. Critical stresses obtained in testing were compared with theoretical values determined by using a discrete arrangement of reinforcing ribs. As the number of stringers reinforcing the shell increased, with the number of ribs remaining unchanged, it was found that the experimentally determined critical axial compressive stresses approached the stress values determined by linear theory. The number of annular ribs gave the same result. For a comparatively high internal pressure, buckling of ribbed shells compressed by axial forces may not occur because of the development of bending strains. M.W.R.

N66-20955 Lockheed Missiles and Space Co., Sunnyvale, Calif.

STABILITY OF A CYLINDRICAL SHELL UNDER LONGITUDINAL IMPACT

V. I. Borisenko *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 125–130 refs (See N66-20946 10-32)

An investigation is made of the axisymmetric buckling of a cylindrical shell under longitudinal impact by a moving solid body during the time of forward wave passage. A linear geometric formulation is presented, although nonlinear terms containing the longitudinal force are used in the equations for shell vibrations. Both initial and boundary conditions are accounted for, as well as resonant velocities and buckling. M.W.R.

N66-20956 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE LOCAL STABILITY OF STRUCTURALLY ORTHOTROPIC SHELLS

E. F. Burmistrov *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 131–135 refs (See N66-20946 10-32)

Within the scope of linear theory, the problem of local stability of structurally orthotropic shells is reduced to the integration of two equations which account for reduced bending and tension stiffness, normal and shear stresses, deflections, and the stress function. An expression is evolved for the magnitude of critical loading. Stability of spherical and cylindrical shells is also considered, and modifications are given for obtaining critical loads in these cases. M.W.R.

N66-20957 Lockheed Missiles and Space Co., Sunnyvale, Calif.

NONLINEAR PROBLEM OF THE STABILITY OF A CYLINDRICAL ORTHOTROPIC SHELL UNDER AXIAL COMPRESSION AND TRANSVERSE PRESSURE

A. A. Bushtyrkov *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 136–143 refs (See N66-20946 10-32)

A nonlinear solution is presented for the stability of a circular cylindrical shell under the effect of axial compression and transverse pressure, and a detailed numerical analysis is presented. The stability problem is solved by the Ritz method, the boundary conditions of the shell are satisfied, and an expression for shell energy is evolved. Equilibrium states of the system are determined from the condition of minimum energy. Lowest value of the stability coefficient under axial

compression was determined by computer. The problem is simplified and the stability of a short shell, and its minimum energy condition, is examined. Critical pressure of medium length shells is determined, and an expression is given for the lowest value of the critical external pressure. It is noted that, in contrast to values for isotropic shells, the stability coefficient under axial compression of an orthotropic shell is not constant but depends essentially on the elastic constants of the material. M.W.R.

N66-20958 Lockheed Missiles and Space Co., Sunnyvale, Calif.

STABILITY OF FINITE PLATE DEFORMATIONS

S. I. Vol'vich *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 144–149 refs (See N66-20946 10-32)

Stability is considered for the case of a rectangular plate fabricated from an isotropic elastic material and, therefore, capable of exhibiting considerable deformation while retaining constant volume. Stability of finite plate deformations is represented by an approximate method. Certain dependencies are established for the bending moments; and from an analysis of the equilibrium conditions of an elementary plate which has sustained large longitudinal strains, the differential dependence between the moments and the longitudinal forces referred to unit length of the deformed plate is the same as in the more usual case. A solution is also given for a plate which is hinge-supported along the sides. Results indicate that the standard method of analysis for large deformations yields a significant error even for the minimum critical loading. These differences in critical loading values are explained by changes in the geometric dimensions and the stiffness of the plate which occur under large deformations. M.W.R.

N66-20959 Lockheed Missiles and Space Co., Sunnyvale, Calif.

SOME PROBLEMS OF THE STABILITY OF SHELLS AFFECTED BY RANDOM PERTURBATIONS

M. F. Dimentberg *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 157–162 refs (See N66-20946 10-32)

Mean number of excursions of an image point outside the limits of a phase plane domain bounded by equal-energy lines and, in particular, one of the separatrice loops is calculated for the simplest model of a shell with one degree of freedom under the effect of exponentially-correlated random disturbances. Random motion of such a system is determined by a second order stochastic differential equation, and the problem of calculating the mean number of intersections per unit time is considered. An expression is also given for the probability of the generalized coordinate crossing the potential barrier in unit time; as is the equation for use in estimating system stability relative to random perturbations. M.W.R.

N66-20960 Lockheed Missiles and Space Co., Sunnyvale, Calif.

STABILITY OF A UNIFORMLY COMPRESSED PLATE IN THE GENERAL CASE OF THE NONLINEAR STRAIN THEORY FOR SMALL DEFORMATIONS

D. D. Ivlev and I. D. Legenia *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 172–178 refs (See N66-20946 10-32)

Examination is made of an elastic material for which the stress-strain dependence is physically nonlinear and the strains are considered small. It is assumed that the strain potential is a function of the second and third invariants of the stress deviator, and nonlinear relationships between the stress deviator, and nonlinear relationships between the stress and strain states are used to investigate the buckling process of a thick rectangular slab under the effect of a compressive loading. Expressions are given for the strain potential of an isotropic body, and the determination of stress and strain components. Boundary conditions on the lateral surface of a buckling slab free of stresses are determined; and by equating the characteristic determinant to zero, an equation for critical stress determination is evolved. Critical loading of a thin plate is given in a nondimensional form. M.W.R.

N66-20961# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE ANALYSIS OF THE STATIC BUCKLING OF SHALLOW RODS AND SHELLS "IN THE LARGE" AS A DYNAMIC PROCESS

V. S. Kalinin *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 179–188 refs (See N66-20946 10-32)

A dynamic approach is used to analyze the static buckling of shallow rods and shells which occurs with snapping proceeding as a damped vibrational process and results in a new stable equilibrium position of a qualitatively different mode. Isolation of the perturbations which cause the snapping is possible with a dynamic approach. The method of the small parameter in combination with successive approximations is used to analyze the buckling process of a shallow shell or rod loaded by a transverse static pressure. A system of nonlinear ordinary differential equations in the unknown expansion coefficients is obtained, and these equations are integrated by using a digital computer. Various substitutions and approximations are made, and the solution of the zero-th approximation is considered in more detail. A numerical example is given and various probability curves are plotted. M.W.R.

N66-20962 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE QUESTION OF THE STABILITY OF CIRCULAR CYLINDRICAL SHELLS UNDER COMPRESSION

S. N. Kan *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 189–194 refs (See N66-20946 10-32)

Formulas derived for determining the stability of a circular cylindrical smooth shell under compression are found to give good results for large values of the shell radius-to-thickness ratio. The computational method refers to a transverse loading, which is equivalent to some initial deflection of the stressed state. Transverse loading may sharply reduce the carrying capacity of shells when the equivalent initial deflection approaches the critical harmonic. It is also pointed out that large irregular local dents may affect the stability slightly, and may have very small amplitudes expanded in Fourier series for the harmonics adjacent to the critical. M.W.R.

N66-20963 Lockheed Missile and Space Co., Sunnyvale, Calif.

SEMILINEAR THEORY OF THE STABILITY OF CYLINDRICAL SHELLS

N. A. Kil'chevskii and S. N. Nikulinskaia *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 195–200 refs (See N66-20946 10-32)

The method of equal linearization is considered as a means of solving nonlinear problems related to the static and dynamic stability of cylindrical shells. Crux of the method is

the construction of a linearly deformed body. Under deformation, a quasi-specific strain energy is developed which satisfies the requirement of the least square deviation from the energy of the nonlinearly deformed body. Stability of a circular cylindrical shell compressed along the generators by uniformly distributed forces is investigated, and qualitative results are presented. M.W.R.

N66-20964 Lockheed Missiles and Space Co., Sunnyvale, Calif.

STABILITY OF A CYLINDRICAL SHELL WITH AN ELASTIC FILLER UNDER LOADING AND TEMPERATURE

B. A. Korbut *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 201–206 refs (See N66-20946 10-32)

Stability of a medium length thin cylindrical shell subjected to loading and heating is investigated by using linear shallow shell equations. Boundary conditions on the endplates correspond to hinge support and admit some radial displacement. Axial and external loadings are uniform, torsion is accomplished by two concentrated moments, and temperature is uniformly distributed throughout the shell. The elastic filler, simulated by a Winkler foundation, increases the number of waves in the circumferential direction by disposing them at a greater angle to the cylinder axis. For the range of variation of filler stiffness used, the number of half-waves in the axial direction equals one. Temperature, which has a slight influence on the nature of the wave formation, diminishes the number of waves in the axial direction while increasing the number in the circumferential direction. M.W.R.

N66-20965 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE STABILITY OF A SPHERICAL SHELL UNDER UNIFORMLY DISTRIBUTED PRESSURE

N. K. Lebedeva *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 207–212 refs (See N66-20946 10-32)

An investigation is made of the non-shallow spherical shells under the effect of a uniformly distributed loading and with the buckling accompanying the formation of axisymmetric dents. The curved surface is approximated by a fourth degree polynomial, and the approximation assumes that the outline of the curved surface as well as the deflections and the dent area will change during the development of post-critical deformations. On the basis of the principle of possible displacements, a variational equation is obtained which is evolved into the Bubnov-Galerkin equation and a subsequent solution. The obtained curve for the equilibrium state shows that all possible axisymmetric curved modes are unstable, and that a protuberance may start from each unstable equilibrium state if the system receives small perturbations. Both first approximations and more accurate results are given. M.W.R.

N66-20966 Lockheed Missiles and Space Co., Sunnyvale, Calif.

DYNAMIC STABILITY OF A CLOSED CYLINDRICAL SHELL UNDER COMBINED LOADING NOT PERIODIC IN TIME

O. P. Protsenko and V. S. Pavlovskii *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 213-221 refs (See N66-20946 10-32)

A smooth hinge-supported cylindrical shell with an initial deflection comparable to the shell thickness is examined to determine the buckling mode under a given loading, which is identified with the time of explosive growth of the deflection. Influence of velocity on loading, magnitude of the initial deflection, and various combinations of axial compressive and transverse pressure loadings on the buckling are also considered. Total deflection, consisting of initial and additional elastic deflection cuased by the applied loading, is approximated and the hinge-fixing conditions of the shell are thereby satisfied. The obtained system of differential equations are applicable to systems with more rapid application of external forces than previous equations allow. It is shown that critical loading is lowered as the value of the initial deflection rises, and this result is magnified as the velocity of the loading increases. M.W.R.

N66-20967 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE ANALYSIS OF THE STABILITY OF THIN-WALLED ROD-SHELLS UNDER FINITE DEFORMATIONS

V. D. Raizer *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. 1965 p 222-228 refs (See N66-20946 10-32)

Fundamental dependences of the nonlinear theory of elasticity are used to derive equilibrium of thin walled rod-shells under finite displacements. Consideration is given to large angles of twist, position of the rod cross section, longitudinal displacement, and torque. In determining the tangential stress, the condition expressing the longitudinal equilibrium of the shell element is used. As compared with Vlasov theory, additional nonlinear components are found to originate under constrained torsion "in the large." Equilibrium equations for a thin walled rod are evolved, and various boundary conditions are considered. It is shown that the stability and instability domains may be determined graphically by constructing integral curves in the phase plan. M.W.R.

N66-20968 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE ANALYSIS OF SHELLS MADE FROM CORRUGATED MATERIALS

V. I. Shalashilin *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 229–235 refs (See N66-20946 10-32)

Consideration is given to a symmetrically corrugated plate element and an anisotropic plate of the same planform dimensions and thickness, both of which are deformed under identical loading conditions. Hooke's Law relationships are detailed, and expressions are given to define the shear and torsion of the middle surfaces of the two kinds of plates. Moments which tend to diminish the curvature of corrugation generators and cause a tension perpendicular to the corrugation are accounted for, as are the initial imperfections in the shell. Upper critical loading of the axial compression of a circular cylindrical shell with longitudinal corrugation is determined, and the case of axisymmetric strain is discussed. A special form for the deflection is given for investigating non-axisymmetric deformations, and extremum conditions are considered. M.W.R.

N66-20969 Lockheed Missile and Space Co., Sunnyvale, Calif.

STABILITY OF ELASTIC SHELLS OF REVOLUTION UNDER A SUDDENLY APPLIED PRESSURE

L. I. Shkutin *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 236–242 ref (See N66-20946 10-32)

Elastic snapping possibilities are discussed for revolving thin walled shallow shells subjected to sudden loading by a uniform, external pressure. The axisymmetric motion of such

a shell, considered as a system with one degree of freedom, is described by a Lagrange equation. Conditions are set to determine the critical value of the loading parameter and the corresponding limiting value of the amplitude. The critical value of a suddenly applied pressure is determined qualitatively for a revolving shallow shell. To carry out numerical calculations for very shallow shells, the deflection considered is similar to that of a circular plate under static pressure loading. Calculations are presented for both conical and spherical shells with different boundary conditions. M.W.R.

N66-20970 Lockheed Missile and Space Co., Sunnyvale, Calif.

DEFORMABILITY AND STABILITY OF COMPRESSED-BENT RODS BEYOND THE ELASTIC LIMIT

G. E. Bel'skii *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 243–249 refs (See N66-20946 10-32)

Carrying capacity of compressed-bent rods in the elastic-plastic stage is investigated, and their deformation in the force plane beyond the elastic limit is considered. Computational dependences are presented for the equilibrium states, and equilibrium stability is analyzed for changing values of the external loading parameter. It is concluded that the fundamental equilibrium states of a compressed-bent rod in the elastic-plastic stage, under increased external loading, are stable; under conditions of decreasing external loading, the equilibrium states are unstable. The fundamental equilibrium state is found to be indistinguishable under conditions of invariability of the external loading parameter. When the repulsion of a compressed-bent rod in the elastic-plastic stage becomes equal to the value of the effective longitudinal compressive force, the fundamental equilibrium state will be critical. Part of the section, in such a case, experiences additional compression while the other part experiences unloading. The unloading is an inevitable phenomenon during the buckling of a compressed-bent rod beyond its elastic limit. M.W.R.

N66-20971 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON A NONCONSERVATIVE PROBLEM OF THE STABILITY OF THE PLANE BENDING MODE

E. A. Beilin *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 250–254 refs (See N66-20946 10-32)

Critical value of the moment applied to the free endplate of a cantilever strip is considered as an example of a nonconservative problem of the stability of a plane bending mode. It is shown that the use of the static method, in the Euler sense, to determine critical loading is applicable only under certain limited conditions. Attention is given to some special cases with the moment vector of the couple rotating around both the X and Z axes, and during buckling, bulging, or curving of the strip. M.W.R.

N66-20972 Lockheed Missiles and Space Co., Sunnyvale, Calif.

SOME MATHEMATICAL METHODS OF INVESTIGATING THE DYNAMIC STABILITY EQUATIONS OF SYSTEMS WITH MANY DEGREES OF FREEDOM

V. I. Derguzov, V. N. Fomin, and V. A. Iakubovich *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 255–266 refs (See N66-20946 10-32)

The relationship of an elastic system and the truncated system obtained by some iteration method, as well as the construction of stability domains in the parameter space of the truncated system are considered in a paper dealing with mathematical methods for investigating dynamic stability of systems with many degrees of freedom. Several theorems are presented, and fundamental and combined resonance are discussed. The system is considered to be asymptotically stable for sufficiently small perturbations of fundamental resonance. The introduction of friction as small as desired may broaden the dynamic instability domain, which indicates the special danger of combined resonance for some equations of the theory of dynamic stability. M.W.R.

N66-20973# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON CRITICAL STATES AND STABILITY OF STRUCTURES LOADED BY HIGH VELOCITY LOADINGS

A. B. Morgaevskii *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 267–275 refs (See N66-20946 10-32)

Loading motion is considered in the form of a very long, theoretically infinite strip along a rectilinear beam located on two supports. It is assumed that this motion has been continuous for a long period of time so that all the vibrational processes associated with the loading have damped and the beam is in equilibrium under the effect of external loadings and centrifugal forces. Boundary conditions are set and a critical velocity concept is derived. Theoretical problems related to moving loadings and to longitudinal bending are found to be analogous by the obtained definition of critical velocity. Consideration is given to a cantilever beam loaded by a rapidly moving strip of uniformly distributed masses. The fundamental differential equation is retained; boundary conditions are set; and, using the Bubnov-Galerkin method in a first approximation, a cubic equation is constructed to determine the dynamic deflection during the motion of loading. Various assumptions are made regarding the beam axis, and special formulas are presented for each case. Problems in free and forced vibrations are also investigated, and appropriate graphs are included.

N66-20974 Lockheed Missiles and Space Co., Sunnyvale, Calif.

STABILITY OF ELASTIC-PLASTIC COLUMNS UNDER BRIEF DYNAMIC LOADINGS

A. K. Pertsev and A. Ia. Rukolaine *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 276–283 refs (See N66-20946 10-32)

The influence of buckling and hardening of materials from dynamic and inertial overloading is investigated by using a rectangular elastic-plastic prismatic column. The equation for column motion is given, the bending mode of the column deflection is taken in the form of a sinusoid, and it is assumed that bending moment varies along the column length. Exact solutions for the motion equation are obtained when the column is in the elastic stage; when there are plastic deformations, an approximation results. Residual deflection of the column after the effect of loading is determined; and dynamic loading is considered dangerous when it leads to residual deflection which reduces the static critical loading by 10%. Dangerous loadings and column bukcling are also discussed; and some dangerous and critical loadings in a column are graphed. M.W.R.

N66-20975 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON RAISING THE THREE-DIMENSIONAL STABILITY OF THIN-WALLED COLUMNS

V. I. Reut *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 284–291 refs (See N66-20946 10-32)

Results are presented for tests made of the pure torsion of two reinforced welded, thin-walled beams of identical cross section in a paper dealing with the three-dimensional stability of thin-walled columns. Fundamental principles of such systems are discussed; and a system of plates in space is considered along with its equilibrium. Attention is given to a thin-walled, open-profile column reinforced by laths and ribs; as well as to the construction of bridges of electric-bridge cranes. Experimental designs have shown that the weights of the main beams of crane bridges can be substantially reduced. M.W.R.

N66-20976 Lockheed Missiles and Space Co., Sunnyvale, Calif.
EXPERIMENTAL VERIFICATION OF THE V. Z. VLASOV THEORY OF THREE-DIMENSIONAL STABILITY OF THIN-WALLED RODS
S. I. Stel'mach *In its* Selected Papers from a Conf. on Stability Probl. in Structural Mech. [1965] p 292-302 ref (See N66-20946 10-32)

Experimental confirmation presented for the Vlasov theory of three-dimensional stability of thin walled rods indicates the importance of correct shape selection for structures. Mechanical properties of the material are also very important; for example, the carrying capacity of short T-beams of equally large section elements may be raised significantly by using steel of a high elastic limit, but no such change results for a T-beam with an elongated wall. Results are graphed for the theoretical and experimental investigation of the change in the critical forces as a function of the section shape as well as the eccentricity of application of the longitudinal force. Analysis of the obtained curves indicates that the influence of section shape is more significant for eccentric than central compression. Critical force lines indicate that these forces should be determined as a function of the position of the forces relative to the center of bending of the section rather than to the center of gravity. It is shown that existing stability theory formulas yield exaggerated values of critical forces. M.W.R.

N66-20983# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
REPORT ON THE MEETING OF THE DURABILITY AND AEROELASTICITY SCIENTIFIC COMMITTEE ON 19 NOVEMBER 1964 IN BRUNSWICK [BERICHT UBER DIE SITZUNG DES FACHAUSSCHUSSES FESTIGKEIT UND AEROELASTIZITAT AM 19. NOVEMBER 1964 IN BRAUNSCHWEIG]
W. Schnell und W. Thielemann 30 Nov. 1965 59 p refs In GERMAN
(DLR-65-15) CFSTI: HC $3.00/MF $0.50

The importance of modern computer methods and machines for the production of airplanes is discussed. An idealized construction model can be used to compute the unknowns and to develop the desired statistical values. Matrix transfer mechanics, incorporating all mechanical values at important section points can evaluate deformation and stability factors and are especially suitable for rocket construction. Statistical computer calculations with the ARGYRIS program for an airplane body stabilization produced relatively good agreement between theoretical and measured values. Application of a statistical method to continuing error linearization in matrix calculations is outlined.
Transl. by G.G.

N66-21027*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TECHNIQUES FOR THE MEASUREMENT OF THE FLEXURAL RIGIDITY OF THIN FILMS AND LAMINATES
Howard L. Price Washington, NASA, Apr. 1966 34 p refs (NASA-TN-D-3270) CFSTI: HC $0.50/MF $0.50 CSCL 11D

The method employs the principle of the heavy elastica which relates flexural rigidity to the deflection of the material under its own weight. Results are presented of tests to determine the stiffness of plastic films and plastic-metal laminates for use in space structures experiments. Tests were performed on untreated and aluminized poly[ethylene terephthalate] film, aluminum foil, and laminates of aluminum foil and poly[ethylene terephthalate] film or polypropylene film. The thickness of the materials ranged from 0.00018 inch (0.00046 cm) to 0.00270 inch (0.00691 cm). The weight efficiency in flexure is presented, the efficiency of the aluminized poly[ethylene terephthalate] film (Echo I material) being taken as unity. It has been shown that the principle of the heavy elastica (including both the heartloop and the cantilever methods) is valid for such determinations if the material does not have a static electric charge. Although higher stiffness can be obtained at the expense of more weight, the investigation showed that the rigidity can increase more rapidly than the weight. Compared with the Echo I material, the laminates had the highest efficiencies of the materials that were tested. A comparison between the flexural stiffness determined by a standard stiffness tester and that determined by the heavy-elastica method revealed that the results of the two methods correlated well only for comparatively large values of stiffness.
Author

N66-21053*# TRW Systems Group, Redondo Beach, Calif.
VOYAGER SPACECRAFT. VOLUME V: ALTERNATE DESIGNS, SUBSYSTEMS CONSIDERATIONS, APPENDIX I
30 Jul. 1965 492 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951113)
(NASA-CR-71475; TRW-5410-0005-RU-001) CFSTI: HC $7.92/MF $2.50 CSCL 22B

A brief analysis of the factors affecting the interface between the spacecraft and a video imaging experiment is presented; and the influence of scene luminance, ground speed, altitude, and attitude control limit cycle rate on achievable resolution is examined. The effects of the space environment on Voyager subsystems are discussed, with emphasis placed on the possibility of damage from solar, terrestrial, and Mars radiation. Also considered is the possibility of damage from collisions with meteorites. Calculations to determine the thicknesses of structural panels for various probabilities of having no puncture from meteoroid bombardment are given, along with detailed strength and dynamic analyses for the respective structural configurations of the solid propellant and liquid propellant retropropulsion subsystems. A general thermodynamics analysis is included for the thermal louvers, insulation, heat shorts, exhaust plume heating, and surface temperature gradients. D.T.

N66-21095*# TRW Systems, Redondo Beach, Calif.
EXPERIMENTS ON THE IMPACT-LIGHT-FLASH AT HIGH VELOCITIES
J. F. Friichtenicht Washington, NASA, Mar. 1966 31 p refs (Contract NASw-936)
(NASA-CR-416) CFSTI: HC $0.45/MF $0.50 CSCL 20K

Described are experiments on the impact light flash conducted with very small (approximately 1 micron) particles over the velocity range from about 2.5 km/sec up to nearly 40 km/sec. The results of measurements using unfiltered

photomultiplier tubes suggested that the emission spectrum was similar to that of a blackbody radiator. Apparent blackbody temperatures were measured by two-color photometric techniques similar to those used by Rosen and Scully, and similar results were obtained over the range of velocities common to both experiments. However, a significant departure from the rate of increase of temperature with velocity predicted by Rosen and Scully was observed. Although no attempt was made to determine the source of radiant energy, it appears likely that two sources exist: One is blackbody emission from heated material, the other radiation from excited atoms in the vapor cloud. The results are related to meteorite detection systems and to basic studies of hypervelocity impact phenomena. M.R.W.

N66-21104# IIT Research Inst., Chicago, Ill.
EVALUATION OF THERMAL PROTECTIVE SYSTEMS FOR ADVANCED AEROSPACE VEHICLES, VOLUME I Interim Summary Report, Sep. 1962–Dec. 1963
W. J. Christian, J. L. Bliton, J. W. Dally, J. C. Hedge, H. J. Hirschhorn et al Wright-Patterson AFB, Ohio, AF Mater. Lab. Apr. 1965 259 p refs
(Contract AF 33(657)-9407)
(AFML-TDR-64-204, Vol. I; AD-627139) CFSTI: HC $6.00/MF $1.25

The report contains summaries of: Surveys of the literature on structural and design aspects of thermal protection systems, on compatibility of refractory materials, on thermal and mechanical properties of refractory materials, and on methods for measuring emittance of materials at high temperature. Experimental determination of the thermal conductance of plasma sprayed coatings of alumina-nickel and zirconia Nichrome types. Measurements of total normal emittance of materials in an oxidizing atmosphere at temperatures of 1000 to 4000°F. Experimental investigations of the effects of composition on the thermal expansion and total normal emittance of zirconia and magnesia. Analytical and experimental studies of the general characteristics and weight requirements of transpiration cooled nose caps using porous metal surfaces. Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-19838 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
THERMAL CONTROL OF SPACECRAFT
Gary D. Gordon *In its* Space Electron. [1965] p 50–53 refs (See N66-19827 10-31)

An understanding of the thermal environment within a spacecraft and the methods for its efficient control under widely varying conditions in space is vital to the success of manned (and unmanned) space missions. In addition, for manned missions the design of protective "space suits" for astronauts must consider proper thermal control. This paper describes the important basic thermal parameters in space, and discusses some of the techniques for thermal control. It is shown that relatively simple thermal control is adequate for a variety of space missions. Author

N66-19953 Joint Publications Research Service, Washington, D. C.
SOLAR RADIATION ENTERING A HOTHOUSE
P. F. Rzayev *In its* Heliotechnology 28 Feb. 1966 p 38–43 refs (See N66-19946 10-03) CFSTI: $3.00

Actinometric data made outside a hothouse were used to calculate the entry values of solar radiation into the hothouse and to compare the obtained date with experimental values. Analyses of direct, diffuse, and scattered solar radiation graphs indicated that the error of the calculation method was about 10 to 15%. The amount of energy entering the installation averaged 50 to 55% of the outside radiation. G.G.

N66-19972# Joint Publications Research Service, Washington, D. C.
ORIGIN AND GROWTH OF CRACKS IN SOLIDS AS AFFECTED BY CHARGE DESIGN
L. M. Marchenko 28 Feb. 1966 16 p refs Transl. into ENGLISH from Vzryvnoe Delo, Nauchn. Tekhn. Gorn. Obshchestvo, sb. (Moscow), v. 54, no. 11, 1964 p 102–113
(JPRS-34323; TT-66-30764) CFSTI: $1.00

Charge design characteristics and their effects on crack formation in 8 mm thick mirror glass benches were studied by high-speed camera. Formation and growth of demolition cracks were characterized by the appearance of radial cracks running from the charge in the direction of the free surface. After a relatively short time, from the lateral free surface and arrived at the origin of the crack growth with some resulting cleavage effects. The volume of breakdown developing from the charge was considerably larger than the volume of breakdown due to the reflected wave. A comparison of demolition effects from continuous charges, charges with circular air gaps, and charges with an air gap showed the greatest destruct effect for charges dispersed by air gap. The latter method altered the explosion mechanism by redistribution of its energy and thus increased the explosive force. G.G.

N66-20004# United Kingdom Atomic Energy Authority, Harwell (England). Applied Physics Div.
EXPERIMENTAL HEAT PIPES
K. F. Bainton Jun. 1965 14 p ref Submitted for Publication
(AERE-M-1610)

Two sodium filled heat pipes were constructed and operated successfully. The principle of their operation is discussed, the method of construction is described, and the potential of these devices is assessed. H.S.W.

N66-20084*# Itek Corp., Palo Alto, Calif. Vidya Div.
AN EVALUATION OF FREE-FLIGHT TEST DATA FOR AERODYNAMIC HEATING FROM LAMINAR, TURBULENT, AND TRANSITIONAL BOUNDARY LAYERS. PART II: THE X-17 REENTRY BODY
John D. Murphy and Morris W. Rubesin 11 Apr. 1965 99 p refs *Its* Rept.-181
(Contract NAS7-216)
(NASA-CR-70931) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Several theoretical methods are described and applied for predicting the aerodynamic heating of blunt reentry bodies. The results of these various prediction methods are compared with the experimental heat rates inferred from flight-test data. The data used in this report were obtained from two

flights of the X-17 reentry test vehicle. The methods employed in the smoothing and reduction of the measured temperature-time data are described in detail. Author

N66-20112# Naval Ammunition Depot, Crane, Ind.
IGNITION THEORY: APPLICATION TO THE DESIGN OF NEW IGNITION SYSTEMS
Duane M. Johnson 24 Nov. 1965 22 p refs
(RDTR-56; AD-627257) CFSTI: HC $1.00/MF $0.50

A theory is presented on the ignition of solid compositions. The effect of certain physical, chemical and thermal properties of a solid composition on the ignition time and ignition energy is explained and supported by experimental evidence. Different types of ignition systems are described. Problem areas of the normal ignition systems are discussed and a technique to overcome these problem areas is offered. By use of the developed ignition theory and a hot-bath immersion test apparatus, a technique of determining the true ignition temperature of a composition is described. Author (TAB)

N66-20173# Air Force Systems Command, Wright Patterson AFB, Ohio. Foreign Technology Div.
ON THE CALCULATION OF A PRESSURE RISE ON A COMBUSTION FRONT
N. N. Bakhman 3 Jan. 1966 13 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 1, 1965 p 106–108
(FTD-TT-65-1771/1+4; AD-626965) CFSTI: HC $1.00/MF $0.50

The problem of computing the pressure rise in the case of simultaneous combustion is discussed and equations are presented for several cases of unidimensional combustion. It is noted that the method presented gives the order of magnitude of the pressure change; however, the value of the pressure change is not exact. E.E.B.

N66-20175# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THEORY OF ACOUSTIC INSTABILITY IN SOLID PROPELLANT ROCKET COMBUSTION
R. W. Hart and F. T. Mc Clure Apr. 1964 56 p refs
(Contract NOw-62-0604-c)
(TG-335-17; AD-626720) CFSTI: HC $3.00/MF $0.50

The problem of unstable combustion in solid propellant rockets is reviewed, with special emphasis on the status of theory and, where possible, the comparison between theory and experiment. General topics include the general nature of the problem; linear theory of acoustic response of burning propellants; and the status of finite amplitude theory. TAB

N66-20181# Aerojet-General Corp., Sacramento, Calif.
GEMINI STABILITY IMPROVEMENT PROGRAM (GEMSIP). VOLUME 4: BAFFLE DESIGN STUDIES Final Report
W. J. Nord et al 31 Aug. 1965 255 p refs
(Contract AF 04(695)-517)
(GEMSIP-FR-1, Vol. 4; SSD-TR-66-2, vol. 4; AD-626769) CFSTI: HC $6.00/MF $1.25

The report is concerned with the design analyses performed in order to design a cooled baffle for the GEMSIP injector configuration. Section I covers the design and testing of a water cooled baffle from which local hydraulic and heat flux measurements were obtained from the interior of a Titan combustion chamber while firing. Section II presents the heat transfer analyses based upon the data obtained from the water cooled baffle. Parametric studies relate gas side wall temperatures, coolant velocity and pressure drop for different baffle shapes, tube spacing, and wall thickness. From these studies are drawn design data for three different cooled baffle concepts. Section III discusses the design of a composite baffle made from copper with a protective covering which has improved heat conduction characteristics. This permits designing for lower coolant velocity with attendant decrease in the required differential pressure. The design principle has application also for other purposes where high heat flux is a problem. Included is a discussion of currently practicable fabrication procedures for such a baffle. Section IV is a report describing the development of improved steady state one dimensional momentum and energy equations with special application to rocket chamber tubes, manifolds, and injector baffles. Special attention is paid to the effects of channel curvature and dimensional changes on local wall temperatures and pressure losses. TAB

N66-20186# Midwest Research Inst., Kansas City, Mo.
MATERIALS RESEARCH FOR HEAT TRANSFER FLUIDS Technical Documentary Report, Feb. 1964–Mar. 1965
Karl R. Mecklenburg Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1965 45 p refs
(Contract AF 33(657)-10295)
(ML-TDR-64-16, Pt. III; AD-627170) CFSTI: HC $2.00/MF $0.50

Liquid metals have certain properties that make them candidates for heat transfer use in aerospace systems. The objective of the investigation was to determine the magnitude of the heat transfer coefficient of condensation for sodium. The supplementary work with the larger, Type 347 stainless steel boilers is presented, including the description of the boilers and operating procedure. The heat transfer experiments were conducted in a closed boiler system, in which the sodium was boiled in the lower region and condensed upon an instrumented surface in the upper region. The results of the operation are presented, showing the heat transfer coefficient for condensing sodium to be between 65.9 and 951.6 Btu/hr-sq ft-degrees F for the conditions studied. These heat transfer coefficients are lower than predicted and there is no apparent correlation in the data. The large data scatter and low coefficient values were attributed to the random formation of condensate (in which case condensation may occur on only a portion of the total condensing area) and the larger resistivity to heat transfer through the additional condensate layer. Author (TAB)

N66-20193# Lockheed Missiles and Space Co., Sunnyvale, Calif.
HEAT TRANSFER FROM A CYLINDRICAL SURFACE WITH A DENSE NETWORK OF RIBS
I. B. Tsesarskii [1965] 9 p refs Transl. into ENGLISH from Inzh. Fiz. Zh. (USSR), v. 9, no. 6, 1965 p 783–787

The heat transfer in lubricating oil from an intensely heated copper surface with a dense network of ribs was studied. The temperature field and the heat transmission coefficients from the heated surface to the cooling fluid were obtained by forming the differential equations for the heat propagation for the ribs and the heat balance for the fluid. The Laplace transform of these equations and their boundary conditions was then used to compute the heat transmission coefficients and to find an expression for the magnitude of the maximum heat transfer coefficient if the fluid temperature was constant over the whole channel section. G.G.

N66-20202# Boeing Scientific Research Labs., Seattle, Wash Flight Sciences Lab.
TURBULENCE MEASUREMENTS WITH INCLINED HOT-WIRES

F. H. Champagne (Ph.D. Thesis—Washington Univ.) Dec. 1965 178 p refs *Its* Rept.-103
(DI-82-0491)

The directional sensitivity of a hot-wire anemometer, the causes of observed departures from normal component cooling, and the errors in selected turbulence quantities caused by assumed normal component cooling were analyzed. Heat transfer measurements from wires inclined to a subsonic air flow indicated a greater heat loss than those from normal positioned wires. Data were correlated by the formula:

$$U_E^2(\alpha) = U^2(0)\,(\cos^2\alpha + k^2 \sin^2\alpha)$$

where $U_E(\alpha)$ is the effective cooling velocity at the angle α between the normal to the wire and the mean flow direction, and U(0) is the velocity at $\alpha=0$. The value of k depended mainly upon the length-to-diameter ratio (l/d) of the wire. Infrared measurements of the temperature distribution along inclined and normal wires indicated nearly identical end conduction heat losses for both positions, although temperature distribution on the inclined wire was slightly asymmetrical. Hot-wire response equations, to include the effects of the tangential velocity component as well as the nonlinearities caused by high intensity turbulence and by low intensity turbulence, were derived and applied to an X-wire array in order to determine the error in selected turbulence quantities that would arise from the assumption of cosine law cooling. G.G.

N66-20232# California Univ., Livermore. Lawrence Radiation Lab.
THE AERODYNAMIC HEATING OF A VEHICLE TRAVELING AT SUPERSONIC VELOCITIES THROUGH A COMPRESSIBLE FLUID
John Harri 23 Jul. 1964 44 p refs
(Contract W-7405-ENG-48)
(UCRL-7807) CFSTI: HC $2.00/MF $0.50

An equation is derived which describes the wall temperature of a vehicle traveling at supersonic velocities through a compressible fluid. A solution of this equation is obtained by the use of the 7094 computer for both laminar and turbulent boundary layers using the Van Driest boundary layer shear stresses. Example calculations pertaining to the High Altitude Diagnostics rocket are included to demonstrate the use of the theory. Author (NSA)

N66-20243# Aktiebolaget Atomenergii, Stockholm (Sweden).
EFFECT OF BUOYANCY ON FORCED CONVECTION HEAT TRANSFER IN VERTICAL CHANNELS—A LITERATURE SURVEY
Ajay Bhattacharyya Mar. 1965 27 p refs
(AE-176)

A survey was made of available information on the effects of free convection flow on forced convection heat transfer in vertical channels. Both theoretical and experimental investigations are included. Nearly all of the theoretical investigations are concerned with laminar flow with or without internal heat generation. More consistent data are available for upward flow than for downward flow. Curves are presented to determine whether free convection or forced convection mode of heat transfer is predominant for a particular Reynolds number and Rayleigh number. At $Re_b > 10^5$ free convection effects were found to be negligible. NSA

N66-20289# Michigan Univ., Ann Arbor. Heat Transfer Lab.
LOW HEAT-FLUX BOILING OUTSIDE VERTICAL AND HORIZONTAL TUBES Final Technical Report
John A. Clark, Herman Merte, Jr., William C. Elrod (Ph.D. Thesis), and Edward R. Lady Mar. 1965 232 p refs
(Contract AT(38-1)-260)
(SROO-260-6) CFSTI: HC $6.00/MF $1.25

An investigation was made of the heat transfer from the outside surface of single 3/4 in. diameter tube to high-purity saturated water in the pressure range from 535 to 1550 psia. Heat transfer characteristics were examined under natural convection conditions and at a velocity of 4.7 ft/sec with the tube oriented horizontally (in cross flow) and vertically (with flow parallel to the axis). The heat flux range of interest extends from the non-boiling region through incipient boiling to a low heat flux in the nucleate boiling region. Three commercial heat exchanger tube materials were considered to examine the effects of variation of material properties and surface condition on the boiling characteristic curve. It is shown that close control of water chemistry is required to assure attainment of reproducible boiling data in the pressure range of this investigation. The dissolved oxygen content and level of suspended solid material in the boiling fluid are important parameters which must be maintained as nearly zero as practicable. The water pH does not have a direct effect on the boiling heat transfer characteristics but is important, especially in ferrous metal systems, in the control of oxidation. Non-boiling forced convection heat transfer from the outside surface of horizontal tubes to high-pressure saturated water is correlated by the generally accepted equation for flow normal to a cylinder. For flow parallel with a vertical tube the equation for heat transfer from a flat plate may be used. In this study of the vertical tube the heat transfer coefficient did not vary with axial position since fully developed turbulent flow conditions existed. Natural convection non-boiling data may be represented by an equation of the following type: $Nu = C(Gr\ Pr)^{1/4}$. The value of the constant C required in this equation for heat transfer to high-pressure saturated water is approximately four times that reported by other investigators for studies at atmospheric pressure. Equations given which represent the natural convection nucleate boiling data obtained are of the form: $q/A = f(P)\,(T_W - T_{sat})^n$. The coefficients, f(P), and exponents, n, of these equations are affected by the pressure, tube material, and tube orientation. It is concluded that the non-boiling heat transfer characteristics are independent of material properties and for forced convection conditions may be predicted by generally accepted correlation equations. Incipient boiling points and nucleate boiling heat transfer are affected by pressure, velocity, tube orientation, and tube material. The more corrosion-resistant materials support higher surface superheat without boiling than do those more susceptible to corrosion. In the nucleate boiling region the variation of $T_O - T_{sat}$ for Monel, Inconel, and carbon steel is small at a given heat flux but the slope of the characteristic curve is so steep that a large variation in heat flux results at a given value of $T_O - T_{sat}$. Hence a single boiling characteristics curve cannot be used to represent the nucleate boiling region for various materials under the conditions of this investigation without introducing large error. Author (NSA)

N66-20316# Sandia Corp., Albuquerque, N. Mex. Radiant Heat Div.
COMPARISON OF HEAT-FLUX SENSORS USING THERMAL RADIATION SOURCES
J. A. Barber Jun. 1965 11 p refs Presented at the 20th Ann. Conf. of the Instr. Soc. of Am., Los Angeles
(Contract AT(29-1)-789)
(SC-DC-65-1507; CONF-651002-1) CFSTI: HC $1.00/MF $0.50

An investigation of discrepancies observed in measurements of thermal flux rates from radiating graphites is reported. Simultaneous measurements were made using thermal flux sensors of three different designs. Similar measurements were made of thermal flux rates from quartz infra-red lamps. Thermal flux sensors having 180° view angles without windows were used in the investigation, the purpose being to examine the effects of possible emissivity changes on the unprotected sensors. Author (NSA)

N66-20385# California Univ., Livermore. Lawrence Radiation Lab.
THERMAL RESISTANCE OF CONTACTING SURFACES: HEAT TRANSFER BIBLIOGRAPHY
Carlotta M. Vidoni 17 Jun. 1965 17 p refs
(Contract W-7405-ENG-48)
(UCRL-14264) CFSTI: HC $1.00/MF $0.50

A bibliography of approximately 100 references is presented on interface contact resistance and related subjects such as surface heat flux and temperature measurements. The bibliography covers the period 1938 to May 1965 and is arranged alphabetically. NSA

N66-20386# California Univ., Berkeley. Inst. of Engineering Research.
THERMAL STRESSES DURING RAPID TRANSIENT HEATING. PART 2: THERMAL STRAINS IN TUBES DURING TRANSIENT HEATING TO 2000°F Final Report
J. Frisch and W. H. Giedt Feb. 1965 46 p refs Prepared for Calif. Univ., Livermore, Lawrence Radiation Lab.
(Contract W-7405-ENG-48)
(AS-65-3; UCRL-13147, Pt. 2) CFSTI: HC $2.00/MF $0.50

The application of reluctance type displacement transducers for the measurement of high temperature strain was investigated. A prototype model was devloped for measuring the radial strain of cylindrical thin-walled tubes subjected to transient internal convective heating from a plasma stream. It consisted of two diametrically opposed probes with ceramic tips which were spring-loaded against the test model. Radial movement of these probes was measured with two calibrated reluctance type sensors. tests were conducted using Type 304 stainless steel, tantalum, and molybdenum cylinders. Average wall temperature increase rates were on the order of 300°F per second. Under these conditions the instantaneous temperature variation through the cylinder walls was found to be negligible. Strain measurements were made up to temperatures above 2,500°F. Excellent agreement between these measurements and calculated results was found up to 2,000°F. Author (NSA)

N66-20395# Atomics International, Canoga Park, Calif.
SRE HEAT TRANSFER SYSTEM DEMOLITION
J. O. Nicholson 31 Aug. 1965 25 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-11414) CFSTI: HC $1.00/MF $0.50

Demolition operations were carried out on the heat transfer systems as part of the SRE Power Expansion Program. The preparation for the demolition and the removal and disposal of the heat transfer systems are discussed. The radiation experience is considered briefly. NSA

N66-20407# Los Alamos Scientific Lab., N. Mex.
THE NON-EQUILIBRIUM DIFFUSION EQUATION
B. E. Freeman 17 Sep. 1965 18 p refs
(Contract W-7405-ENG-36)
(LA-3377) CFSTI: HC $1.00/MF $0.50

The system of equations describing the diffusion of radiation through material is discussed from the point of view of the formulation for numerical solution. These equations, which are more general than the equilibrium diffusion equation, contain terms describing (a) cooling of material by radiation in optically thin systems, (b) diffusion of radiation through material with or without energy exchange with the material, and (c) an approximation to the free streaming of radiation. Consequently, they are applicable to a much wider range of radiation transport phenomena than the equilibrium diffusion equation. The several regions of applicability are examined from the point of view of the structure of the equations and the frequency dependence. Finally, the general non-equilibrium diffusion equations are discussed regarding appropriate mean absorption coefficients for frequency groups. Spatial and time dependences of the difference equations are also considered. Author (NSA)

N66-20417# Los Alamos Scientific Lab., N. Mex.
CHILLDOWN AND STORAGE LOSSES OF LARGE LIQUID HYDROGEN STORAGE DEWERS
D. H. Liebenberg, R. L. Stokes, and F. J. Edeskuty [1965] 14 p refs Presented at the Cryogenic Eng. Conf., Houston, Tex.
(Contract W-7405-ENG-36)
(LA-DC-7164; CONF-650802-3) CFSTI: HC $1.00/MF $0.50

The time history of the boiloff gas quantity was measured and compared with the total measured liquid input for a 55,000 gallon LH_2 storage dewar. These measurements showed that this vacuum perlite insulated dewar chills more quickly and requires less liquid hydrogen for chilldown than is generally calculated from theory. The measured steady state heat flux is less by a factor of 2 than conservative calculations would predict. Author

N66-20432# European Atomic Energy Community, Brussels (Belgium).
DETERMINATION OF THERMAL CONDUCTIVITY IN SATURATED VAPORS OF BENZENE, DIPHENYL, o-TERPHENYL, m-TERPHENYL, AND p-TERPHENYL [BESTIMMUNG DER WARMELEITFAHIGKEIT DER GESATTIGTEN DAMPFE VONBENZOL, DIPHENYL o-,m-, UND p-TERPHENYL]
F. W. Reiter and W. Link 1965 28 p refs In GERMAN
(EUR-2282.d)

In a stationary hot wire apparatus thermal conductivity of the saturated vapors of diphenyl, *o-*, *m-* and *p*-terphenyl was measured up to pressures of 2 or 3 atmospheres, that of saturated vaporous and liquid benzene up to near the critical point. The experimental error is estimated to be less than 2%. A plot in reduced units showed that thermal conductivity of saturated vapors of similar substances fulfils the law of corresponding states very well. Author

N66-20445# European Atomic Energy Community, Brussels (Belgium).
DETERMINATION OF THE LATENT HEAT OF FUSION OF o-TERPHENYL AND m-TERPHENYL [BESTIMMUNG DER SCHMELZWARME VON O- UND M-TERPHENYL]
G. Friz, E. Boullet-Krayer, and R. Nehren Jan. 1965 12 p In GERMAN
(EUR-2223.d)

The latent heat of fusion of o- and m-terphenyl has been determined with a simple method of technical precision. The heat per second entering into the sample has been measured by a fluxmeter and recorded. Thr time-integral per mass yields the latent heat of fusion. Naphthalene and diphenyl have been taken for calibration substances. Impurities of the sample substance influence very much the behavior of the fusion process. Author (NSA)

N66-20446# Los Alamos Scientific Lab., New Mexico.
HEAT TRANSFER IN MISSILES AND SPACE OPERATIONS
Keith Boyer [1965] 21 p refs Presented at Symp. on Heat Flow Below 100°K and its Technol. Appl., Grenoble, France
(Contract W-7405-ENG-36)
(CONF-650611-2; LA-DC-7224) CFSTI: HC $1.00/MF $0.50

A brief review is presented of heat transfer studies of propulsion system problems at cryogenic temperatures. These problems include storage of liquid hydrogen, forced convection heat transfer to liquid hydrogen, transient heat flow, and system dynamics. NSA

N66-20506# Oak Ridge National Lab., Tenn.
SUPERHEAT WITH BOILING ALKALI METALS
J. A. Edwards and H. W. Hoffman [1965] 23 p refs Presented at the 4th High-Temp. Liquid-Metal Heat Transfer Tech. Conf., Argonne Natl. Lab, Argonne, Ill., 28-29 Sep. 1965 Submitted for Publication
(Contract W-7405-ENG-26)
(ORNL-P-1659; CONF-650946-1) CFSTI: HC $1.00/MF $0.50

The results of experiments in a natural-circulation loop to establish the magnitude of the superheat associated with alkali-metal boiling are reported. For potassium boiling on an as-received (commercially smooth) surface, the superheat measured ranged from 500°F at a saturation temperature of 1500°F down to 230°F at T_{sat}=1770°F. Wall-temperature oscillations, which occur in the presence of these large superheats because of the unusual thermal properties of the liquid metals, were of the order of 170 to 300°F at a frequency of 1.5 cycles/min. Because of maximum surface temperature limitations, sodium could not be boiled on this surface. Significant reductions in the magnitude of the superheat and, hence, in the amplitude of the wall temperature oscillations were effected by modifying the boiler surface. Thus, on a surface containing eight 0.006-in. diameter×0.040-in.-deep cylindrical holes, the superheat with potassium was reduced about forty-fold below the value obtained on the as-received surface. A porous surface, formed by sintering of stainless steel particles on the inside tube surface, was less effective than the surface with discrete holes but still showed appreciable reductions in the superheat. Similar results were obtained with sodium. Over the limited range of these experiments, the superheat data for both potassium and sodium correlate reasonably with predictions based on a model involving a spherical vapor bubble in thermal equilibrium within a liquid pool of uniform temperature. Author (NSA)

N66-20534# California Univ., Livermore. Lawrence Radiation Lab.
CORRESPONDING STATES AT SMALL INTERATOMIC DISTANCES
R. Norris Keeler, Marvin Ross, Mathias Van Thiel, and Berni J. Alder 20 Jun. 1964 8 p refs Preprint
(Contract W-7405-ENG-48)
(UCRL-7907) CFSTI: HC $1.00/MF $0.50

By measuring the thermodyanmic properties of condensed rare gases to pressures of about half a million atmospheres, it was established within 2% accuracy that argon and xenon obey the rule of corresponding states under extreme conditions of pressure and temperature. At pressures of 200,000 atmospheres and higher, strong deviations from corresponding states become apparent in xenon, which can be traced to large-scale thermal excitation of electrons into the conduction band. Author (NSA)

N66-20545# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
A PULSE HEATING CALORIMETRIC TECHNIQUE FOR MEASURING THE SPECIFIC HEAT OF ELECTRICAL CONDUCTORS AND ITS APPLICATION TO PURE IRON FROM 100 TO 1400°C
T. G. Kollie [1965] 51 p refs Presented at the 5th Thermal Conductivity Conf., Denver
(Contract W-7405-ENG-26)
(ORNL-P-1670; CONF-651020-4) CFSTI: HC $3.00/MF $0.50

A pulse heating calorimetric technique for measuring the specific heat of electrical conductors over a wide temperature range is described. A direct current is used for Joulie heating of an instrumented, rod-type specimen suspended in a constant-temperature, blackbody vacuum chamber. To determine the specific heat, the current flowing through the specimen is pulsed and a digital voltmeter, capable of recording 300 readings per second, measures the time dependence of the temperature change and the power dissipation in a known length of the specimen during the pulse. Radiation losses occurring during the nominally 4-sec pulse are accounted for by using total hemispherical emittance values obtained with the specimen at constant temperature. Errors in thermocouple measurements of surface temperature of a self-heated rod suspended in a blackbody at room temperature were considered on the basis of resistance thermometry for pure iron. An overall error analysis of the technique predicts an accuracy in the specific heat results of ±1.0% from 100 to 800°C. The accuracy and reproducibility of the technique were demonstrated by measurements on pure iron from 100 to 1400°C and by comparison with literature values. Below 910°C the reproducibility was assessed as ±0.5% and the agreement with other investigators was ±2.2%, except in the vicinity of the Curie transformation. The specific heat values from 910 to 1400°C are within 5% of several literature sources. At 772.8°C the specific heat of iron was found to change discontinuously from a value of 0.3457 to 0.2872 cal/g/°C. Consequently, the Curie phenomenon was adjudged to be a second-order transformation caused by a change in the rate of decoupling of aligned atoms at the ferromagnetic to paramagnetic transition. Author (NSA)

N66-20546# Michigan Univ., Ann Arbor. Dept. of Chemistry.
THERMAL ANOMALIES AND THERMODYNAMIC PROPERTIES OF GADOLINIUM HEXABORIDE
Edgar F. Westrum, Jr., John T. S. Andrews, and Gerald A. Clay (Little (Arthur D.), Inc., Cambridge, Mass.) Aug. 1965 10 p refs Presented at the Rare Earth Res. Conf., Ames, Iowa, 31 Aug. 1965
(Contract AT(11-1)-1149)
(COO-1149-52; CONF-650804-9) CFSTI: HC $1.00/MF $0.50

Previously reported studies on the thermal properties of lanthanum and neodymium hexaborides in the cryogenic region have been extended to gadolinium hexaboride, and are presently in progress on cerium hexaboride. Like its neodymium analog, the gadolinium compound shows a cooperative transition apparently associated with antiferromagnetic ordering, with a peak at 16° K. Moreover, a Schottky effect with a maximum heat capacity at 29° K is apparent. The Schottky effect is attributed to 2n and n degenerate levels, separated by 145 and 230 cal/gfm from the n degerate ground state. The entropy contribution from the Schottky level at 25°C is R ln 4, and that associated with the magnetic cooperative transition approximates R ln (2s+1) as would be expected for the complete order of

the (2s+1) levels associated with the spin, $s=^{7}/_{2}$, of the Gd(III) ion. Partial thermodynamic functions for GdB_6 are derived on the basis of these values. Author (NSA)

N66-20580# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL COMBUSTION CHAMBER WITH WATER COOLING

A. A. Mikulin and N. N. Zagryazkin 3 Jan. 1966 18 p ref Transl. into ENGLISH from Teoriya Konstruktsiya, Raschet i Ispytaniye Dvigateley Vnutrennego Sgoraniya (Moscow), v. 5, 1960 p 27–33

(FTD-TT-65-1282/1+2+4; AD-627071) CFSTI: HC $1.00/MF $0.50

A general discussion is given concerning the combustion which takes place within a combustion chamber. TAB

N66-20599# Holman (John F.) and Co., Inc., Washington, D. C.

NEW PRINCIPLE OF IGNITION AND COMBUSTION IN ENGINES [NOVYY PRINTSIP VOSPLAMENENIYA I GORENIYA V DVIGATELYAKH]

L. A. Gussak Ft. Belvoir, Va., Engr. Res. and Develop. Labs., 17 Mar. 1965 22 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSR, Energ. i Transport (Moscow), no. 4, 1965 p 98–110

(Contract DA-44-009-AMC-930(T))

(ERDL-T-1814-65; AD-627098) CFSTI: HC $1.00/MF $0.50

The article considers the shortcomings of internal combustion engines associated with the combustion process taking place in them. It also describes a new principle of ignition and combustion of the working mixture (precombustion chamber jet ignition) and presents data on the improvement of performance in precombustion chamber engines compared with spark ignition engines. These data were obtained during numerous testings of these engines on trucks and light automobiles. Author (TAB)

N66-20602# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINING THE OPTIMUM HEATING RATE FOR CERTAIN BODIES

A. A. Shevelev 11 Jan 1966 14 p refs Transl. into ENGLISH from Iav. Vyssh. Ucheb. Zaved. Energ. (Minsk), no. 11, 1961 p 77–83

(FTD-TT-65-1810/1+2+4; AD-627075) CFSTI: HC $1.00/MF $0.50

The process of heating of bodies of regular geometric form is studied taking into account maximum thermal stresses when the temperature of the medium is a linear function of time. Dependences are obtained which make it possible to determine the optimum rate of heating with respect to the permissible value of maximum thermal stresses for any values of the Biot criterion. Author (TAB)

N66-20650# Welsh College of Advanced Technology, Cardiff.

THERMAL RESISTANCE OF PRESSED CONTACTS

T. R. Thomas and S. D. Probert Risley, England, Atomic Energy Authority, 1965 38 p refs

(TRG-1013 (R/X)) HMSO: 4s 6d

A review of theoretical rdsults and experimental data is presented. It is concluded that the most promising line of attack on problems concerning thermal contact conductances is the use of surface analyzers with data processing equipment to record surface parameters in great detail. Experimentally, there are very large differences between the results of different workers using apparently very similar specimens. There is a need for a standard specimen to be circulated among workers in the field. Author

N66-20686# Atomic Energy Establishment, Winfrith (England). Reactor Development Div.

AN EXPERIMENTAL INVESTIGATION TO DETERMINE THE SCALING LAWS OF FORCED CONVECTION BOILING HEAT TRANSFER. PART 2: AN EXAMINATION OF BURNOUT DATA FOR WATER, FREON 12 AND FREON 21 IN UNIFORMLY HEATED ROUND TUBES

P. G. Barnett and R. W. Wood Aug. 1965 68 p refs

(AEEW-R-443)

The set of physical properties containing the latent heat of vaporization, the liquid and vapour densities, the thermal conductivity and specific heat of the liquid phase and the rate of change of the density ratio with pressure is shown to relate burnout data for water, Freon 12 and Freon 21 in uniformly heated round tubes to within ±7%. Apart from some results which may contain a larger than usual experimental error, the same set is shown to relate the Freon 12 and Freon 21 data to within ±3%. This observation is consistent with the rate of change of the saturation temperature with pressure being an important physical property because, when added to the above set, it produces a dimensionless group of properties which has approximately the same value for Freons 12 and 21, but a significantly different value for water. Author

N66-20699# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

EXPERIMENTS ON BURNOUT IN A UNIFORMLY HEATED ROUND TUBE AT 1000 p.s.i.a. WITH STEAM–WATER MIXTURES AT THE TUBE INLET

A. W. Bennett, G. F. Hewitt, H. A. Kearsey, and R. K. F. Keeys Nov. 1965 34 p refs

(AERE-R-5072)

Experiments are described on the determination of burnout heat flux in a 0.497 in bore tube with heated lengths in the range 3–12 ft for mass velocities of 1 and 2×10^6 lb/ft^{2}h respectively at 1000 lb/in^2 (absolute). Steam was fed to the bottom of the tube and water was introduced around the tube periphery through a porous sinter. It was found that, in general, the use of this type of mixed inlet gave somewhat higher burnout heat fluxes for a given exit quality than did the use of subcooled water at inlet. Many detailed trends were observed which may throw some light on the behaviour of steam–water systems under these conditions. Author

N66-20704# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.

DIRECTIONAL EMISSIVITIES FROM A TWO-DIMENSIONAL, ABOSRBING-SCATTERING MEDIUM: THE SEMI-INFINITE SLAB

R. P. Bobco Mar. 1966 30 p refs *Its* Rept.-5

(SSD-60072R)

A closed-form solution is presented for the directional emissivity at any location on the surface of a semiinfinite slab of an absorbing-scattering medium. The medium is assumed to be a gray, isothermal dispersion which emits, absorbs, and scatters isotropically, and is confined by free boundaries. The solution to this two dimensional problem is found by the approximate technique based on an iteration of the solution to the diffusion equation. Polar plots of directional emissivity are presented which show the influence of optical thickness, surface location, and scattering strength (albedo). Author

N66-20715# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
ONSET OF CONVECTION IN A RAPIDLY ROTATING FLUID SPHERE Technical Report No. 57
F. E. Bisshopp and P. P. Niiler Jun. 1964 29 p refs
(Contract Nonr-562(07))
(Rept.-562(07)/57; AD-601996) CFSTI: HC $0.75/MF $0.50

The nature of the constraint imposed by rapid rotation on convective motions at their onset in a plane liquid layer can be found out from an exact solution of the problem. Here we use the physical insight derived from the simpler problem to formulate an asymptotic approximation to the equations governing the analogous problem in a sphere. The solutions we obtain for the asymptotic equations provide an asymptotic approximation of the dependence of the critical Rayleigh number for the onset of convection on the Taylor number.
Author (TAB)

N66-20719 Aeronutronic, Newport Beach, Calif. Applied Research Labs.
THERMODYNAMIC PROPERTIES OF PROPELLANT COMBUSTION PRODUCTS Quarterly Letter Report No. 1, 1 Jun.–31 Aug. 1965
N. D. Potter [1965] 8 p refs
(Contract AF 49(638)-1577; ARPA Order 317)
(QLR-65-14; AFOSR-65-2295; AD-625044) CFSTI: HC $1.00/MF $0.50

The objective of the program is to provide thermodynamic data for species which are potentially important combustion products of advanced chemical rockets and for species which are related to these. Enthalpy and entropy data are obtained from equilibrium measurements made by torsion free evaporation and torsion effusion techniques and by high temperature mass spectrometry.
TAB

N66-20818# RAND Corp., Santa Monica, Calif.
THE THERMODYNAMICS OF THE GRAPHITE–CARBON VAPOR SYSTEM
F. J. Krieger Dec. 1965 33 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-3326-1-PR; AD-625735) CFSTI: HC $2.00/MF $0.50

The purpose of this study is the thermodynamic investigation of graphite over a range of temperatures up to 6000°K and pressures up to 10^3 atmospheres. Two sets of equilibrium composition equations were used—one representing a pure gas phase, the other a heterogeneous system of gas and solid carbon. The heterogeneous chemical system is unique in that, although it involves two phases and a variety of chemical species, it comprises only one chemical element. The mathematical solution of the system of equations representing the heterogeneous chemical system was subject, therefore, to the physical constraint of one degree of freedom. The results of the computational program are presented in both tabular and graphic form. The latter is a conventional Mollier diagram in which specific enthalpy is plotted against specific entropy, with cross plots of temperature, pressure, molecular weight, and moles of condensed carbon. Author (TAB)

N66-20854# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Strahlantriebe.
INVESTIGATIONS ON FLOW AND COMBUSTION AT V-FLAMEHOLDERS [STROMUNGS- UND VERBRENNUNGSUNTERSUCHUNGEN AN V-FLAMMHALTERN]
L. Wetterstad, R. Ulken, and W. Alvermann 4 Nov. 1965 57 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-55) CFSTI: HC $3.00/MF $0.50

Investigations are made with an afterburner model with V-flameholder on the effect of thrust control on the combustion conditions by means of a stepped injection in circumferential direction. Here, too narrow a distance of the injection tubes leads to poor efficiency and variable distribution of temperature and velocity behind the flameholder. The ignition from one combustion zone to the next one was done satisfactorily with the exception of extreme fuel poor or fuel rich zones. For the uniform and economic thrust control of an afterburner the number of injection tubes has to be reduced towards the center of the combustion chamber with this type of injection.
Author

N66-20864# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
THERMODYNAMICS AND ONE-DIMENSIONAL SHOCK WAVES IN MATERIALS WITH MEMORY
Bernard D. Coleman (Mellon Inst.) and Morton E. Gurtin Aug. 1965 31 p refs
(Contract Nonr-562(40))
(TR-3; AD-626294) CFSTI: HC $2.00/MF $0.50

This paper studies one-dimensional shock waves in materials with long range non-linear viscoelastic memory but do not conduct heat. In particular it generalizes many aspects of the classical theory of Hugoniot curves. Author (TAB)

N66-20885# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
AEROSPACE NUCLEAR SAFETY INVESTIGATIONS OF REENTRY ABLATION PHENOMENA Quarterly Report, Aug. 1–Oct. 31, 1965
John L. Beal, W. R. Brown, R. L. Pleuthner and J. F. Newton Oct. 1965 68 p refs Prepared for Sandia Corp.
(CAL-123-010-1)

The size distribution as determined by target impact is given for debris particles formed in a shock tunnel test from excessive sized liquid zirconium drops. Tests of zirconium hydride under reentry conditions simulated in the Mach 6 section of the Wave Superheater Hypersonic Tunnel are described. The determination of emissivity during an ablation test is reported.
Author

N66-20893*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECT OF SOLAR SIMULATOR OPERATING CHARACTERISTICS ON SPACECRAFT THERMAL TESTS
L. B. Katter and M. E. Kahn 15 Jul. 1964 34 p refs
(Contract NAS7-100)
(NASA-CR-71153; JPL-TM-33-175) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A study has been made to determine the effect of various solar simulator operating characteristics on spacecraft thermal tests. Characteristics considered are: (1) the effects of decollimation, (2) spectral mismatch, and (3) axial and radial variations of energy flux density. In addition, the effect of solar simulator optics in the chamber has been considered for certain special cases.
Author

N66-20924# Bureau of Mines, Berkeley, Calif.
THERMODYNAMIC PROPERTIES OF VANADIUM AND ITS COMPOUNDS
Alla D. Mah 1966 102 p refs
(BM-RI-6727)

For evaluating heat balances, determining trends, and establishing limits of metallurgical processes, a compilation of thermodynamic data on vanadium and its inorganic compounds is presented. The information is based on a critical

survey, and the sources from which the data were obtained are listed. Included are heat capacities, entropies, heat contents, heats of vaporization, free energies of vaporization, vapor pressures, temperatures of phase changes, heats of phase changes, heats of formation, and free energies of formation. Basic data applications are given for heats, free energies, equilibrium pressures, and equilibrium constants of reactions of vanadium compounds with special emphasis on metallurgical reactions. Basic thermodynamic data are supplied for elements and compounds associated with metallurgical reactions of vanadium. Auxiliary data are included so that the calculated values may be followed, or new calculations made for related metallurgical reactions. M.G.J.

N66-20934*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL HEAT-TRANSFER RESULTS FOR CRYOGENIC HYDROGEN FLOWING IN TUBES AT SUBCRITICAL AND SUPERCRITICAL PRESSURES TO 800 POUNDS PER SQUARE INCH ABSOLUTE
Robert C. Hendricks, Robert W. Graham, Yih Y. Hsu, and Robert Friedman Washington, NASA, Mar. 1966 158 p refs
(NASA-TN-D-3095) CFSTI: HC $1.80/MF $1.00 CSCL 20M

Heat transfer to cryogenic para hydrogen was experimentally determined in electrically heated vertical tubes. The investigation covered subcritical and supercritical pressures from 80 to 800 pounds per square inch absolute, mass fluxes from 100 to 1000 pounds per square foot per second, and heat fluxes to 3 Btu per square inch per second. The data were accumulated for a variety of tube test sections ranging from 0.188 to 0.507 inch inside diameter with a heated length from 16 to 24 inches. Similarities in the behavior of the near-critical to two-phase data were noted, including a minimum in the heat transfer coefficient near the saturation or transposed critical temperature. Flow oscillations were noted primarily when inlet conditions were below the transposed critical temperature. Techniques for correlating Nusselt numbers are discussed. The correlations show promise for states where the hydrogen bulk temperatures are above the transposed critical temperature. Extensive tables of the experimental heat transfer data are included to aid rocket cooling passage designers. Author

N66-20990*# Electro-Optical Systems, Inc., Pasadena, Calif.
CONSTRICTED HIGH ENTHALPY ARC HEATER DESIGN AND PERFORMANCE DATA, INCLUDING CALCULATIONS FOR A 10 MW DESIGN First Interim Technical Report
Robert Richter, Rolf D. Buhler, and Gary L. Marlotte 27 Aug. 1965 106 p refs
(Contract NAS9-3564)
(NASA-CR-65239; EOS-6320-2Q-1) CFSTI: HC $4.00/MF $0.50 CSCL 20M

This report presents procedures for the design analysis and performance predictions of constricted (coaxial flow) arc air heaters for materials testing and atmospheric entry simulation. This analysis is based on comparisons of theoretical and experimental results covering constricted arc gas heaters and arc research cascades of various sizes. The experimental heater results cover a power range from about 30 to 1000 kW. The theoretical and semiempirical heater calculations are carried up the 10 mW level. A range of heater enthalpies is covered, with emphasis on the high enthalpy regime (~20,000 to 50,000 Btu/lb or 4.6 to 11.6×10^7 J/kg). This covers the most critical portions of the Apollo and similar lunar parabolic earth return entry trajectories, and the lower half of the Mars return Earth entry spectrum. C.T.C.

N66-20997*# Electro-Optical Systems, Inc., Pasadena, Calif.
HIGH ENTHALPY GAS HEATER Final Report
Robert Richter and Rolf D. Buhler 30 Dec. 1965 169 p refs
(Contract NAS9-3564)
(NASA-CR-65268; ESO-6320-Final) CFSTI: HC $5.00/MF $1.00 CSCL 20M

The development of a one-mW high-enthalpy constricted arc heater which is suitable for materials and structural testing is presented. The heater has a single upstream cathode, a segmented two-cm diameter constrictor, and 30 anode pins located in the supersonic nozzle. The heater was operated over a broad range of stagnation pressures (up to 2 atm), enthalpies (to 57,000 Btu/lb), and power levels (to 1 mW) with exceptional jet stability. A five-hour life test resulted in no appreciable component deterioration or measurable performance change. Complete experimental performance maps are included. Semi-empirical design charts and scaling rules for larger constricted arc heaters are also included. They indicate the general feasibility of a 10-mW heater with enthalpy-pressure performance capabilities similar to those of the one-mW model. Also discussed is the design and fabrication of an axisymmetric (Hall-arc jet) accelerator with an arc power of approximately 0.5 mW. The accelerator was tested with nitrogen at tank pressures to 7 mm Hg, and its capability for continuous operation was demonstrated. C.T.C.

N66-21009*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
RADIANT HEATING SIMULATION First Phase Report, 23 Sep.–10 Nov. 1964
T. K. Pugmire 12 Nov. 1964 41 p refs
(Contract NAS9-3507)
(NASA-CR-65301) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Spectral radiance measurements for nitrogen, oxygen, xenon, and argon gases were made on an arc column apparatus, which is depicted and described, as part of an effort to define the requirements for simulating radiant heat attendant to manned spacecraft during atmospheric entry. Other parameters affecting the spectral radiance, in addition to gas composition, were studied, including pressure and temperature effects. Curves of the experimental data are shown. Literature searches were also conducted for data relating to specific equilibrium heat radiation and spectral radiance distribution for high temperature air. The data are evaluated. L.S.

N66-21010*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
RADIANT HEATING SIMULATION Second Phase Report, 10 Nov.–30 Dec. 1964
J. K. Pugmire 30 Dec. 1964 51 p refs
(Contract NAS9-3507)
(NASA-CR-65302) CFSTI: HC $3.00/MF $0.50 CSCL 20M

An evaluation of existing radiant heater technology was made as part of an effort to define the requirements for simulation of the radiant heating attendant to atmospheric entry by manned spacecraft; and to assess techniques for achieving the simulation. Evaluated as radiation sources are (1) solid and gas discharge lamps, (2) electron beam heaters, (3) resistance or induction heaters, (4) solar radiation, (5) direct arc column heating (using tungsten-argon, and carbon), (6) plasma generators, and (7) lasers. Performance characteristics evaluated for the sources included (a) maximum radiant flux attainable, (b) spatial and temporal uniformity of flux at test

section, (c) spectral distribution of the radiant flux, (d) compatibility with convective heating source, (e) operational characteristics, and (f) economics. Comparison studies were made with radiation data obtained experimentally from shock heated gas, and the data are represented graphically for air as a function of flight velocity. Several schematic diagrams and pictures of radiation source apparatus are also presented. L.S.

N66-21026*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METASTABLE LEIDENFROST STATES
Kenneth J. Baumeister, Robert C. Hendricks, and Thomas D. Hamill Washington, NASA, Apr. 1966 18 p refs Film Suppl. to this rept. is available on request from Lewis Res. Center (NASA-TN-D-3266) CFSTI: HC $0.25/MF $0.50 CSCL 20M

Experiments demonstrate that the lower limit of the plate temperature necessary to sustain Leidenfrost film boiling of a water drop is very near the saturation temperature of the liquid. Starting with a water drop on a hot plate in the stable film-boiling regime, cooling the plate slowly, and taking care to eliminate gross perturbations of the system, the drop can remain in the film-boiling state for plate temperatures as low as the saturation temperature. For plate temperatures in the neighborhood of the saturation temperature, the drop collapses onto the plate surface without nucleation. The present cool-down experiments indicate that the Leidenfrost phenomenon can terminate over a range in temperatures from those reported in the literature down to the saturation temperature depending on the characteristics of the heater surface and system perturbations. In essence, the so-called Leidenfrost point of a liquid drop is a function of the environmental vibrations (natural or induced) and surface conditions (roughness and thermal diffusivity). Thus, for a smooth surface isolated from surrounding vibrations, Leidenfrost film boiling of liquid drops can exist for plate temperatures very near the saturation temperature of the liquid. Author

N66-21038*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF TOTAL EMITTANCE AND SOLAR ABSORPTANCE OF SEVERAL COATINGS BETWEEN 300° AND 575°K
James H. Diedrich and Henry B. Curtis Washington, NASA, Apr. 1966 41 p refs
(NASA-TN-D-3381) CFSTI: HC $0.60/MF $0.50 CSCL 20M

The coating systems tested were the following: (1) a two-component coating consisting of a spinel basecoat and a stannic oxide topcoat, (2) three zinc-oxide pigmented coatings with different binders, (3) two titanium-dioxide pigmented coatings, (4) two lithium aluminum silicate pigmented coatings, and (5) one zirconium dioxide pigmented coating. Both the emittance and absorptance measurements were made calorimetrically on the same test apparatus using the same specimen. The results presented consist of the emittance and absorptance data for each coating as a function of test temperature. Seven of the coatings had emittance values of 0.88 or greater, and eight coatings had absorptance values less than 0.30 over the entire test temperature range. Using measured values of coating mass per unit area (area density) obtained from the test specimens, the coatings tested added a significant fraction to the mass of two sample low temperature space radiator designs. The dependence of emittance and absorptance on coating thickness was established for one of the test coatings and the possible need for an optimum coating thickness with respect to radiator mass is discussed. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-19893# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 296
3 Mar. 1966 31 p refs Transl. into ENGLISH from Hang K'ung Chih Shih (Peking), v. II, no. 2, 7 Feb. 1965 p 12–13, no. 3, 7 Mar. 1965 p 11–13, and no. 4, 7 Apr. 1965 p 4–8, 12–13, 22–23
(JPRS-34378; TT-66-30818) CFSTI: $2.00

CONTENTS:

1. SPACE VEHICLE OPERATIONAL STATIONS H.-i. Ch'ien p 1–5 (See N66-19894 10-11)
2. RADIO TELEMETRY H. Hsun p 6–10 (See N66-19895 10-07)
3. GROUND INSTALLATIONS FOR MAJOR ROCKETS Yu Cheng p 11–15 (See N66-19896 10-11)
4. AIRCRAFT FLIGHT INSTRUMENTS C.-h. Chou p 16–19 (See N66-19897 10-14)
5. OUR MINIATURE ROCKETS C.-y. Lu and C.-h. Li p 20–24 (See N66-19898 10-01)

N66-19926# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
THE ART OF MILITARY CONSTRUCTION—SURVEY OF LITERATURE [KRIJGSBOUWKUNDE—LITERATUURO-VERZICHT]
4 Feb. 1966 20 p refs In DUTCH, GERMAN, and ENGLISH *Its* Vol. 8, No. K-81
CFSTI: HC $1.00/MF $0.50

Abstracts and bibliographic notes are included on the topics of ground mechanics and foundation techniques, roads, airports, photogrammetry and land geometry, civilian utility buildings, construction, building physics, and steel buildings, atomic-biologic-chemical warfare (including general results, shock waves, fallout, and protective constructions), and application of the moire method. Transl. by J.O.

N66-19969# Joint Publications Research Service, Washington, D. C.
RECENT SOVIET STUDIES IN GEODESY AND CARTOGRAPHY
V. P. Alekseyev-Shemyakin, A. P. Zhal'nerukas, and V. V. Ivanov 1 Mar. 1966 18 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 10, Oct. 1964 p 31–36, 42–45
(JPRS-34334; TT-66-30775) CFSTI: $1.00

Discussed are the following topics: (1) *Identification of Petroleum Industry Structures*—aerial photography for mapping of surface petroleum industry equipment and underground pipelines; (2) *Stereo Photographic Survey with One Meter Contour Intervals*—stereo plotting of aerial photographs for topographic maps; and (3) *Accurate Coordinate Determination of Objects on Topographic Maps*—differential calculations between geodetic coordinates and map coordinates for point position accuracy. G.G.

N66-20019# RAND Corp., Santa Monica, Calif.
THE GAME OF SCIENCE
T. A. Cowan Jul. 1965 22 p refs Presented at the Symp. on Philosophy of Sci., Berkeley, Calif., Dec. 1965; Sponsored by the Am. Assoc. for the Advan. of Sci.
(P-3182; AD-618730) CFSTI: HC $1.00/MF $0.50

Conditions for the development of an aesthetic for science are propounded. Consideration of the subject includes the question as to whether the pursuit and practice of science can be regarded as seeking the structure of spontaneous creativity. The most likely manner by which the structure of spontaneous creativity can be handled is concluded to be the 'game of science.' 'Play' is claimed to be the object of the game and to bear the same relation to the professional activity of the scientist, i.e. organized though, that physical exercise bears to everyone. The course of scientific play leads to full exercise of intuition within the rules of scientific method, which rules for the purpose of game play are not the same as those for scientific work. The ordering conception of the game is the notion of system to which each game must conform, the system itself conforming to the requirements of an equilibrium system. An example of a simple game would be to show how a business firm could be driven to bankruptcy by one or all of a number of actions. An example of a complex game would be to design a utopia to replace the City of Los Angeles. The report includes sections on the structure, rules, and postulates of the games. TAB

N66-20031*# Oklahoma State Univ., Stillwater. Coll. of Business.
AN EVALUATION OF ALTERNATIVE TECHNIQUES FOR ESTIMATING COUNTY POPULATION IN A SIX-STATE AREA
Richard W. Poole, James D Tarver, David White, and William R. Gurley 1960 140 p *Its* Econ. Res. Ser. No. 3
(Contract NASr-63-(04))
(NASA-CR-70833) CFSTI: HC $4.00/MF $1.00 CSCL 14D

The evaluation tests were conducted in 564 counties in a six state area, including Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma. It is suggested that the methodological and empirical findings will be of particular interest to people in business, government, and education who use county population etimates. D.T.

N66-20086# Technical Univ. of Istanbul (Turkey).
BULLETIN OF THE TECHNICAL UNIVERSITY OF ISTANBUL, VOLUME 18, NUMBER 1, 1965 [ISTANBUL TEKNIK UNIVERSITESI BULTENI]
1965 135 p refs *In* GERMAN, FRENCH, ENGLISH, and TURKISH
CFSTI: HC $4.00/MF $0.75

CONTENTS:

1. ON INTEGRAL EQUATIONS FOR SMALL OSCILLATIONS OF A HEAVY CHAIN CONSISTING OF TWO HOMOGENOUS PARTS AND FASTENED AT TWO POINTS C. Kocak p 1–6 refs

2. ON THE VIBRATION OF BEAMS CARRYING AN ARBITRARY NUMBER OF CONCENTRATED MASSES C. L. Amba-Rao and E. S. Suhubi p 7–16 refs (See N66-20087 10-32)

3. RELATION BETWEEN THE WORKING PROPERTIES AND THE CURVES OF CONTINUOUS TRANSFORMATION STUDIED WITH MEASUREMENTS OF ELECTRICAL RESISTANCE A. Ersumer p 25–36 refs

4. MAGNETOHYDRODYNAMIC FLOW IN AN ANNULAR CHANNEL IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD M. E. Erdogan p 37–43 refs (See N66-20088 10-25)

5. CALCULATIONS ON BIOCHEMICAL BREAK UP /ELOCITY DURING NATURAL CLEARING OF POLLUTED /ATERS N. Kor p 44–58 refs

6. ON A PROJECTIVE TRANSFORMATION BOUND TO A SPHERICAL PROJECTION S. Akin p 59–77 (See N66-20089 10-23)

7. A NUMERICAL METHOD TO DETERMINE THE UNIT HYDROGRAPH M. Bayazit p 78–86 refs

8. STATISTICAL STUDY OF THE DURATION OF A HELICAL BORE C. Kulur p 87–106 refs

9. A STATISTICAL DESCRIPTION OF DISTRIBUTION OF PHASES D. E. Gucer p 107–125 refs (See N66-20090 10-17)

N66-20178# Illinois Univ., Urbana. Coordinated Science Lab.
THE USES OF PLATO: A COMPUTER-CONTROLLED TEACHING SYSTEM
Donald L. Bitzer, Elizabeth R. Lyman, and J. A. Easley, Jr. Oct. 1965 35 p refs
(Contracts DA-28-043-AMC-00073(E); Nonr-3985(08)) (R-268; AD-623526) CFSTI: HC $2.00/MF $0.50

The use of a high speed digital computer as a central control element provides great flexibility in an automatic teaching system. Using a computer-based system permits versatility in teaching logics since changing the type of teacher merely requires changing the computer program, not the hardware. In addition, having access to the decision-making capacity of a large computer located as one unit permits complicated decisions to be made for each student. Such capacity would be prohibitively expensive to provide by means of decision making equipment located at each student station. The results of exploratory queuing studies show that the system could teach as many as a thousand students simultaneously without incurring a noticeable delay for any student's request. The educational results thus far have been extremely encouraging. However, reliable conclusions on educational achievement must await the results of more thorough experiments now in progress which include larger numbers of students learning under a variety of conditions. The adaptability and useability of the system for a variety of purposes in education and the behavioral and physical sciences have been clearly demonstrated. Author (TAB)

N66-20692# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
SOME APPLICATIONS OF RADIOISOTOPES IN THE FIELD OF CIVIL ENGINEERING
A. Ariizumi Aug. 1965 24 p refs Transl. into ENGLISH from Oyo Butsuri (Tokyo), v. 32, no. 6, 1963 p 411–420
(AERE-TRANS-1044) HMSO: 3s

Applications in civil engineering for nondestructive testing using gamma ray back scattering density meters and neutron moisture meters are reported. In each of the following experiments, the test method is described, calibration curves are given, and results are discussed. (1) The natural pulverization pressure is determined, using both the gamma ray meter and the neutron moisture meter, as one example of roadbed and road foundation condition determination. (2) Four sets of gamma ray determinations of river bed erosion during low and high water periods are reported. (3) The effectiveness of grouting in dam beds was tested by the gamma ray meter. (4) The gamma ray transmission method was used to determine the amount of entrapped air in water overflowing a dam. (5) Density loggings of a sea bed were carried out using a gamma ray

meter for selecting a bridge location. (6) Initial tests of water content distribution in river embankments with a neutron moisture meter are given. N.E.N.

N66-20839# Mitre Corp., Bedford, Mass.
ESTIMATING METHODS AND DATA SOURCES USED IN COSTING MILITARY SYSTEMS
M. V. Jones Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1965 129 p refs
(Contract AF 19(628)-2390)
(TM-04263; ESD-TR-65-396; AD-626153) CFSTI: HC $4.00/MF $1.00

The choice of estimating methods and the selection of data sources are two important, closely allied decisions that a cost analyst makes in estimating the costs of a military system. This report discusses five basic estimating methods, examines the advantages and disadvantages of each, and identifies the types of data required to use each method. The 5 methods are (1) per unit catalog price or planning factor, (2) cost-to-cost estimating relationship, (3) noncost-to-cost estimating relationship, (4) specific analogy, and (5) expert estimate.) Two basic data sources, documented historical evidence and projected expert opinion, are discussed as a means of carrying out these estimating methods. The report also briefly reviews existing data base systems that have been organized to make these data sources available to the cost analyst.
Author (TAB)

N66-20868*# Washington Univ., St. Louis, Mo. Dept. of Economics.
FEDERAL FINANCING OF RESEARCH AND DEVELOPMENT AND THE REGIONAL DISTRIBUTION OF INCOME
Murray L. Weidenbaum Jan. 1966 12 p refs
(Contract NsG-342)
(NASA-CR-71150) CFSTI: HC $1.00/MF $0.50 CSCL 05C

The extent to which the Department of Defense, the National Aeronautics and Space Agency, and the National Science Foundation act as regional income equalizers was studied. Eight income regions were established by computing regional income data for the continental United States. Overall results indicated that none of the major R & D programs served as regional income equalizers. Ranking of the three programs by computing their Gini coefficients, which are measures of relative equality, showed that Defense Department R & D contracts had the greatest tendency to widen per capita regional income variations; NASA occupied the middle position, while the NSF distribution approximated more closely the composite share of population and income. G.G.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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